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UNITED STATES DEPARTMENT OF AGRICULTURE
Research Program Development and Evaluation Staff
Washington, D. C. 20250

REPORT AND RECOMMENDATIONS

of the

FIFTH MEETING

of the

ANIMAL AND ANIMAL PRODUCTS RESEARCH ADVISORY COMMITTEE
Washington, D. C. April 1-5, 1968

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TABLE OF CONTENTS

	<u>Page</u>
PREFACE.....	i
I. General Comments.....	ii
II. General Recommendations.....	vi
III. Facility Recommendations.....	xi
IV. ANIMAL HUSBANDRY & LIVESTOCK ENGINEERING	
A. Reproductive Performance.....	1
B. Feed Efficiency.....	2
C. Environmental Stress in Production.....	4
D. Production Management Systems.....	6
E. Production of Animal Products with Improved Consumer Acceptability.....	10
F. Protection of Food from Harmful Micro-organisms and Toxins.....	10
G. Protect Livestock & Poultry from Toxic Chemicals, Poisonous Plants, & Other Hazards.....	10
H. Alleviate Soil, Water, & Air Pollution..	10
V. ANIMAL HEALTH	
A. Diseases of Livestock and Poultry.....	11
B. Parasites of Livestock and Poultry.....	17
C. Protection from Toxic Chemicals, Poisonous Plants, & Other Hazards.....	18
D. Livestock Insects and Other Arthropods..	19
VI. UTILIZATION, NUTRITION AND CONSUMER USE	
A. Utilization Research.....	19
B. Human Nutrition & Consumer Use Research.	24
VII. MARKETING AND ECONOMICS	
A. Market Quality.....	26
B. Transportation, Equipment, & Facilities.	29
C. Economics of Marketing.....	30
D. Cooperative Marketing.....	33
E. Supply-Demand Research, Situation, Outlook, and Projections.....	34
F. Consumer Attitudes & Preferences.....	36

PREFACE

The fifth meeting of the Animal and Animal Products Research Advisory Committee was held in Washington, D.C., April 1-5, 1968. Mr. Norman Moser, a cattleman from De Kalb, Texas, and a member of the National Agricultural Research Advisory Committee, served as liaison representative between the two committees. Dr. Mehren discussed administrative and budgetary matters with major emphasis on the budget situation and the status of national agricultural research planning and management involving the current research information system and task forces; also, governmental activities pertaining to food safety involving liaison with the Public Health Service and the Food and Drug Administration. Dr. W. D. MacLay, Director, Research Program Development and Evaluation Staff, discussed the status of joint Federal-State planning for research facilities and the activities of the joint research task forces that pertain to livestock and poultry. Dr. N. D. Bayley, Deputy Director for Science and Education, discussed the status of a number of general recommendations made by this Committee during its last four meetings.

During the public session on April 1, the following organizational representatives presented statements pertaining to research needs:

National Dairy Council	Dr. M. F. Brink
Evaporated Milk Association	J. C. Flake
Institute of American Poultry Industries	Lee Campbell
Southeastern Poultry & Egg Association	Mays Montgomery
National Pork Producers Council	Albert Gehlbach
National Wool Growers Association	Edwin E. Marsh
National Livestock and Meat Board	Dr. Wm. C. Sherman
National Live Stock Producers Association	Mylan E. Ross
National Association of Animal Breeders	Philip I. Higley

The following organizations submitted statements to the Committee prior to or during the meeting: The American Leather Chemists Association, The American National Cattlemen's Association, the National Lamb Feeders Association, and the National Turkey Federation. Two observers were in attendance: A. Olivia Nicoll, editor of the Dairy Industry Newsletter, and Dr. Dewey Bond, Washington representative of the American Meat Institute.

As a basis for its recommendations the Committee reviewed research progress reports which were supplemented by oral reports, visual materials, and discussions by leaders of research programs. Following these reviews and discussions, the Committee divided into four subcommittees: (1) animal husbandry and livestock engineering; (2) animal health; (3) utilization, nutrition, and consumer use; and (4) marketing and economics. All subcommittee recommendations were reviewed by the entire committee before they were approved for inclusion in the final report to be submitted to the Secretary of Agriculture.

Additional copies of this report may be requested from Max Hinds, Executive Secretary, Animal & Animal Products Research Advisory Committee, Research Program Development and Evaluation Staff, U. S. Dept. of Agriculture, Washington, D. C. 20250

I. GENERAL COMMENTS

The Importance of a Viable Animal Agriculture

The sector of the nation's economy affected by the research reviewed by this Committee contributes more than half of the cash farm receipts from the sale of agricultural products. Four of the top ranking agricultural commodities in the United States are in this group: beef cattle and products, 19.3%; dairy cattle and products, 17.5%; hogs, 9.6%; and poultry and eggs, 9.5%. Sheep, lambs, and wool contribute about 1%. Also, two-thirds of the protein in our food supply comes from this sector.

At the present time we are in the midst of accelerating changes in agriculture. A brief glance into the past with respect to the livestock sector provides a frame of reference that might help us see these changes in better perspective. The sweep of history over the last century reveals:

- cattle numbers have tripled
- hog numbers increased about $2\frac{1}{2}$ times by the early 1940s and have declined about $\frac{1}{3}$ since
- dairy cow numbers tripled by the early 1940s, then declined to about double the level 100 years ago -- but total milk production remained fairly constant as dairy cow numbers declined
- chickens, other than broilers, have been at a fairly even level during the last thirty years but broilers have increased 70-fold
- turkey production during the last thirty years increased about 4-fold
- about half as many sheep are produced

Consumers in the United States enjoy the best and most varied diets in the world for a smaller percentage of their income than ever before. The proportion of the consumer's dollar spent for food during the last fifteen years has declined from 22% to 18%. Also, consumers have been free to choose among competing livestock products. A look at consumption trends during the last two decades reveals that per capita consumption of beef has gone up 40 lbs. and poultry 18 lbs. while that of pork and lamb declined about 10 lbs. and 1 lb., respectively. While these changes were taking place in consumption of meat and poultry, the per capita consumption of milk in all forms declined slightly more than one-fifth.

In each of our last two reports, under "General Comments" we have expressed concern about the fact that returns to the livestock producer for his land, labor, capital, and management were generally less than that received by workers in other activities. We are still concerned about the welfare of agricultural producers. During the past 15 to 25 years the movement of people out of farming has occurred at an almost unbelievable rate. This has happened without reducing the total production of food due to the fantastic gains in efficiency achieved by agriculture during this period. We believe efficiency of production will continue to improve. In fact, we are certain that it must if our own standards of living are to be maintained while we, at the same time, use our food to assist the underdeveloped countries to stay above starvation diets as populations explode throughout the world.

But, to assure this upward trend in food production, it must be recognized that farming is no longer a small capital investment industry. It takes thousands of dollars more capital per farm worker than is required per worker in nearly any other industry. Capital investments of this size seek their most productive use but farming is not competitive with other forms of invested capital. We must recognize the need for returns in agriculture to be competitive with returns from other uses of capital and labor. Additional research on the economics of agriculture to assure maintenance of a healthy, reasonably profitable free enterprise farm industry is essential.

An Accolade for Disease Control

The Committee commends the Department for the dramatic program developed for control of the screwworm. The sterile-fly technique utilizing irradiation is a striking example of beneficial results that have been made possible because basic research was conducted years ago on the physiology of reproduction. The complete eradication of screwworms in the southeastern part of the U.S. and later in the Southwest have saved stockmen millions of dollars. The cooperation and assistance at the present time with Mexico is contributing to warm and friendly international relations which are so important in today's world.

Also, we commend the Department for perfecting a technique for detection of carriers of foot-and-mouth disease virus.

In-depth Study of the Dairy Industry

The Committee was pleased to learn that a joint Federal-State dairy research task force was established in August 1967. We recommended an in-depth study at our March 1966 meeting and in our 1967 report called attention to some specific problem areas that had been presented to us by representatives of dairy organizations. At the present time we think the following observations are pertinent to such a study:

Consumers in the United States spend a smaller proportion of their real income for food than in any other country in the world. This low cost of food is taken for granted and consumers assume it will continue forever. Unfortunately, drastic changes are occurring in the dairy farming community. The movement of dairymen away from the farm in recent years has occurred at an incredible rate. It is becoming increasingly evident that the very existence of the dairy industry is threatened by this trend and the factors causing it. The number of dairy farms in the U. S. has decreased almost 80% since 1950 and the size of the national dairy herd has declined almost 50%. Even though research results have helped dairy farmers to increase milk production 65% per cow since 1950 and to reduce the labor requirements for producing the total milk supply by 50%, dairy farmers and cows have continued to decline in numbers. These trends cannot be allowed to continue if this industry is to survive and provide the dairy products required by consumers. The situation is further amplified by the fact that all farm costs of production have increased an estimated 35% during the past twenty years.

The declining dairy situation is largely attributed to increased costs of production, the steady and heavy demands on labor, and more favorable off-farm or other agricultural commodity opportunities. While the average net farm income has been estimated at approximately \$5,000 annually, capital investments are high and commonly exceed \$100,000, the demand of farm chores continues from dawn to dusk each day and the return per man-hour of labor is low, probably averaging less than the nationally \$1.60 required minimum wage. The man-hours of labor required to return \$100 on dairy farms in the U.S. has been estimated at 18 and is considerably more than the estimate of 12 for beef and only 6 for broiler production.

The consequences of this rapidly declining national dairy herd is of great concern. In 1960, 17.5 million milk cows on farms averaged 7,029 pounds of milk each and provided a national milk supply of approximately 123 billion pounds. In 1967 the corresponding figures were 13.5 million cows, 8,821 pounds of milk each for a total of 119 billion pounds of milk. If this trend continues, milk cow numbers will decline 3.3% annually and the yield per remaining cow will increase 3.6 annually. On this basis there will be 8.9 million cows in 1980 averaging 13,790 pounds of milk each and producing a national milk supply of 123 billion pounds. This projected supply will be 5% short of the 130 billion pounds of milk estimated to be needed by 1980. It should be cautioned, however, that the trend in declining cow numbers could be greater and the production per cow could be less during the next thirteen years than the amount indicated above. For example, the decline in number of milk cows was 3.7% in 1965 and 5.7% in 1966. Also, it is well known that continued increases in production per cow tend to be more difficult to obtain at higher levels of performance.

Short of increased subsidies and much higher milk prices, it is apparent that dairy farmers are in urgent need of improved technology with which they can reduce the cost of production and improve labor and farm efficiency.

With so many of today's problems in the dairy industry occurring off the farm, there is need to increase utilization and marketing research. If, hopefully, some of the industry's longstanding shackles should be lessened in the future, e.g., definition of butter in 1923 by Congress with no change in forty-five years, there could be research opportunities in new and modified products that are presently illegal. If the pricing structure on a classified use basis should be modified in the future to recognize the declining value of fat and increasing value of solids, another research door would be opened. Further work on cottage cheese stability is needed. The industry has annually 22 million pounds of whey that is a disposal problem and might become a useful product.

The historical pricing structure on a classified use basis can be questioned. About two-thirds of the nation's milk supply is sold under administered prices -- slightly more than half under Federal milk marketing orders and the remainder under State regulations. This pricing procedure needs further and continuing analysis as the trend toward

larger "order-areas" continues which may lead to regional or ultimately a national "order-market." The economic impact of regulations of all kinds needs objective analysis. The long decline in per capita consumption is evidence of changing consumer preferences. Modern purchases by large distributing firms on a basis of product specification is on the increase.

Modern merchandising and distribution create new and challenging problems. The industry cannot be served with economic intelligence pertaining to these everchanging problems with limited research fragmented over numerous problems.

Sheep Industry Important to America's Welfare

The place of the sheep industry in our American economy needs continued attention with stronger research support. Sheep are raised in most States. In many areas they provide important supplemental income and in other areas, major income. Sheep can utilize lands not otherwise used. Lamb offers consumers another pleasant meat choice. Despite the many new fibers, wool still remains very important to this country's defense needs. The health and growth of the American sheep industry is being threatened by mounting competition with synthetic fibers and foods, by increased costs of raising sheep, by mounting imports of raw and manufactured products, and by changing consumer preferences along with changing structures of textile marketing, manufacturing, and retailing. Part of the recent decline in domestic sheep numbers is due to the sharp reduction in lands available for raising sheep due to our population increase. Our population increase has placed greater demand for lands traditionally used for sheep. This includes lands for recreational areas, watersheds, and wildlife preserves. But, as our future food and fiber requirements increase, the competitive position of the sheep industry can only be held strong through vigorous research that makes possible superior sheep products at lower costs.

The Future of Pork

Years ago, when substantial portions of our population required high energy foods to power the activities of human labor, pork was a favorite food. Curing methods enhanced pork's storability and contributed to its usage. Mechanization has reduced man's expenditures of physical energy and has provided refrigeration so important to the preservation and transportation of fresh meats.

These changes make the survival of the pork industry dependent upon its adaptation to a lean meat role. Trends in per capita pork consumption during recent years were partly a consequence of the period required for a fatty pork to lean pork transition. The response of the pork industry to the need for change has been dramatic. Breeding herds have in a period of twelve years increased meatiness from 48% lean cuts to approximately 56% lean cuts (on a carcass basis) through selection against fatness. Reductions in the amount of feed required for growth due partly to genetic selection and due partly to improvements in feedstuffs have also been substantial.

Opportunities for business efficiencies associated with the mass production potentials of confinement rearing and with the potentials of continuing genetic change suggest the survival capability of this very important livestock industry. Expanded technology promises numerous possibilities for the future enhancement of the pork role in agricultural industry.

Elsewhere in this report many suggestions are made in order to emphasize useful areas in which USDA expanded research efforts can and should contribute to the development of this technology.

The self-help efforts of swine farmers through its agency, the National Pork Producers Council, are testimony to the importance which they attribute to increased activity focused on this industry -- one that generates more than 9% of our cash farm receipts.

II. GENERAL RECOMMENDATIONS

Funding Research Programs

The Committee recognizes the need for and supports the policy of reduced governmental expenditures but the Committee expresses its desire that agricultural research receive no more than its proportionate share of such economies and urges that, as new funds become available, additional research projects be directed into such fields as marketing and disease prevention as well as production. It is estimated that over \$3 billion yearly could be added to producer incomes through production efficiencies which expanded research could develop at no additional cost to the consumer. Furthermore, substantial cuts in research funds at this time could seriously jeopardize our ability to produce the necessary food and fiber for ourselves and others in the decades ahead.

Need for Consumer Awareness on Food Safety

The Committee continued to recommend increased emphasis on dissemination of information on proper food handling practices to consumers and food handlers. While research will continue to improve the detection and control of potential pathogens in the food supply, this in itself will not eliminate all outbreaks of food-borne illness.

The Committee has noted the establishment of the Interdepartmental Committee on Food Safety including the Department of Agriculture; the Department of Health, Education, and Welfare; and the Department of Interior. This Committee is urged to place high priority on developing new methods and channels for promoting safe food handling practices among consumers and food handlers. An educational program reaching the homes, institutions, and food handling establishments must be developed to accomplish a thorough job of controlling salmonella and other pathogens involved in food illness outbreaks.

The Committee acknowledged the increased activity of the Department in research and in the dissemination of research on salmonellosis and other food-borne diseases. A joint effort with the Food and Drug Administration has established a National Academy of Sciences-National Research Council Salmonella

Study Committee to define the parameters of the problem. The Committee urges that these activities be extended in the most effective way by contacts with food processors and handlers and the consuming public.

National Diet-Heart Disease Study

The Committee recommends that if a larger scale national diet-heart disease study is undertaken by the National Institutes of Health, the Department of Agriculture attempt to establish a cooperative relationship which will allow its nutritionists to actively participate in the design and selection of methodology in the study.

Increased Education and Liaison

The Committee recommends that additional emphasis be given to disseminating the results of research in dairy utilization. Its primary objective would be to convey and demonstrate results of new research which might contribute to more effective and expanded utilization of dairy products to personnel of the nation's dairy products industry. Another important objective would be to relay problems of industry back to research workers. The type of extension service work that was carried out by contract between the University of Maryland and the Federal Extension Service needs to be re-established. This brought research results to the attention of food manufacturers.

Antibiotics

Antibiotics are used extensively in poultry production for growth stimulation and disease control. Consumer-oriented regulatory agencies have become concerned about development of antibiotic-resistant organisms in livestock and poultry which might continue to exist when consumed as human food and thus pose a threat to human health. Also, other regulatory agencies have become concerned about the efficacy of such antibiotics when used at low levels for growth stimulation in poultry. Research is needed to prove or disprove each of these challenges to the use of antibiotics. Poultry is especially suited for studies to determine whether such claims are true.

Support of Graduate Training in Animal and Poultry Science

The role of USDA in the support of graduate training largely through the Cooperative State Research Service has contributed substantially to the development of animal scientists. The need to assure continued support at State Agricultural Colleges and State Experiment Stations is emphasized since specific training, motivation, and experience contribute substantially to the stability and availability of personnel so essential to future research efforts.

Imbalance of Funds for Animal Husbandry

The Committee was disappointed to find there had apparently been no correction of the imbalance in assignment of funds to animal husbandry research as compared with other fields of agricultural research that has occurred during the past few years. The Committee has for the last two years urged correction of this imbalance and is concerned about the lack of action shown to date.

Last year it was pointed out that although animal agriculture contributes 56% of the cash receipts from farm marketings and the most important sources of protein in amount and quality, it is receiving less than one-third of the funds expended for farm research.

Livestock Statistics

The Committee commends the Statistical Reporting Service for its vigorous effort to improve the accuracy of livestock statistics as explained in the presentation of the program.

Because this service is so essential to the entire livestock industry, it was felt that last year's recommendation was still applicable and worthy of repetition:

"Research should be conducted that would indicate how to achieve greater accuracy in the January 1 livestock inventory report issued each year. The inventory reports are based on census enumerations as a benchmark. In intercensus years, the year-to-year changes are based on sample surveys. When census data become available, it is necessary to review the estimates for the previous five years and, if necessary, make revisions to bring the level of estimates in line with census enumerations. These revisions accumulate over the five-year period and at the end of the period can result in a change of several percentage points. Even though the changes are small for each individual year, the cumulative change at the end of the period frequently causes considerable concern in the industry. With the technological changes that have taken place during the past ten years or more, further research on methods of collecting data would be beneficial in helping to attain greater accuracy in current reports. Of greatest concern is the methodology being used to establish the statistical base for reporting and to recognize the variables that occur which cause fluctuations between estimates and actual. Since these reports are used for all manner of business decisions in the livestock industry and for research, it is important that they be as accurate as possible."

In addition, it was indicated that horses for recreation may constitute an industry of \$4½ billion annually and is growing rapidly. Census information as to numbers of such horses is nonexistent. It would be helpful to many agricultural-based enterprises to have data that would provide information as to the number of such horses, the number of mares and stallions of breeding age, and the number of foals produced yearly. The Committee suggests that consideration be given to obtaining such information.

Importation of Exotic and Foreign Breeds for Breeding Purposes

Useful characteristics not present in U.S. livestock exist in various parts of the world. Incorporation of this germ plasm into our livestock could improve productivity substantially. For example, Finnish Landrace sheep produce litters of lambs rather than one to three. A system could be developed to take advantage of this extra lamb production efficiency to the benefit of sheepmen and consumers alike. Equal opportunity undoubtedly exists in cattle, swine, and other animals. The Committee recognizes the need to protect American

livestock from diseases which might be brought in by importation of animals. However, the Canadian government has demonstrated that if proper procedures are followed, animals can be brought in from foreign countries. Using existing germ plasm is less expensive and far quicker in obtaining results than developing it from American animals. Consequently, we recommend that the Animal Health Division proceed to develop a program for the United States that will make importation of animals possible.

Livestock Waste Disposal

One of the fastest growing problems of livestock production relates to the disposal of livestock manure. Rapid increases in size of feedlots, dairy operations, and poultry production units -- often located near growing centers of human population -- have given rise to an almost overwhelming problem of animal waste disposal. The Committee recommends that the Agricultural Engineering Research Division of the Agricultural Research Service should give accelerated attention to this problem and allot as many scientists and funds to its solution as possible. The Committee feels that this is a problem of agriculture and, as such, should be handled by ARS rather than scientists from the Department of Health, Education and Welfare; Commerce; or Interior. In studying this problem especial attention should be given to odor control, reuse of litter, profitable utilization of organic matter in animal waste, and prevention of stream pollution.

Rabbit Research

Because of the needs of medical science for laboratory animals, the possibility of a new meat source comparable to poultry, the potential advantages of rabbit production as income opportunities for the elderly and the young, and an enterprise that lends itself to semiurban areas, it is recommended that a rabbit research program be conducted involving the disciplines of husbandry, nutrition, genetics, physiology, pathology, utilization, and marketing, and that a coordinating mechanism or authority be established to direct the program.

This area of research might well be conducted within existing research divisions without establishing a separate station, however, it is important that the coordinating mechanism be sufficiently effective to avoid the overlooking or neglect of the program so that it becomes the stepchild in a division where investigators are not interested in it. It may have been in the public interest to close the separate rabbit experiment station but there is concern as to whether it is in the public interest to withdraw research from this industry at a time when its economic importance may be close to a major breakthrough as a full member of the agricultural sector of the economy.

Rabbit production is important in support of medical research and other aspects of basic life science research. Animal numbers are far below actual demand for medical research and teaching. Rabbit production offers an important potential source of meat. These animals share with poultry many desirable characteristics such as adaptability to widely decentralized production. Compared with poultry as an enterprise, rabbits have the ability to grow on rations comprised largely of low-cost and low-usability roughage whereas poultry require rations of concentrates and feedstuffs that are more or less in competition with the

human population. There may be a possibility for this infant industry to generate into a major food industry. Rabbit projects in 4-H clubs have demonstrated the feasibility of production by young persons. Likewise, elderly persons could take advantage of the low capital cost to start a business. The small size of the animal and its gentle nature are factors that make handling suitable for young and old. Rabbit production is better suited to development in semiurban areas than most animal operations. There are fewer noxious wastes and less likelihood of the operation becoming a community nuisance.

The immediate research needs are for more information on methods of detection and control of rabbit diseases and parasites, methods for more efficient production, and methods for improving the quality of the animals. Specifically, the biomedical research use of these animals would be greatly enhanced by production of disease- and parasite-free rabbits of greater animal to animal uniformity. Research on the elimination of "snuffles" in rabbits may well provide valuable spin-off information on the control and elimination of shipping fever in cattle.

Swine as a Laboratory Animal in Human Medical Research

The development of the miniature pig for medical research stems from the great similarity of swine and human biological processes. Expansion of basic biological knowledge on swine is of tremendous importance in many areas of human research. Increased use of swine in medical research may well relieve some use of pet-type animals in such work but depends on developing a fund of basic biological data comparable to that available on other medical research animals. The needs of human research for an additional nonrodent mammal justify the expansion of basic swine research efforts. Recent breakthroughs in human medicine and surgery (notably organ transplants) point up the timeliness of this need.

Laboratory, Pet, and Recreational Animals

An earlier recommendation in 1965 pertained to pet animals, indicating the importance as an industry amounting to several hundred million dollars annually. The responsibilities of the Department to administer the Laboratory Animal Welfare Act intensifies the importance of the need for research on diseases of these animals.

The numbers of pet and recreational animals continue to increase as man has more leisure time and movement to suburban and semirural areas takes place. Sales of animal products and byproducts that are used to feed such animals make large contributions to the income of livestock producers. There is great need for more knowledge about diseases of these animals.

III. FACILITY RECOMMENDATIONS

Agricultural Research Center, Beltsville, Maryland

Again, the Committee strongly urges and recommends that steps be taken by the Department of Agriculture to apprise our congressional leadership of the "down-at-the-heels" condition of facilities at Beltsville and that an all-out effort be made to obtain necessary funds to recondition, replace, and modernize existing buildings and facilities. This is a showplace for the research effort of the nation. Many high-ranking visitors never see anymore of our research effort than at Beltsville and their impression of this facility will influence their thinking about all research in the nation.

This is a justifiable concern both from the aesthetic as well as the research operations point of view. Research problems and the techniques, equipment, staffing, and related needs have changed over the years. Physical, budgetary, and authority limitations restrict adjustment dictated by need. Space in current facilities is about the same as it was thirty years ago and is not conducive to economical and efficient research and operational use.

During the past five years this Committee has called attention to the very urgent need for an appropriate slaughterhouse, autopsy room, and incinerator in order to properly handle carcasses of experimental animals and to comply with sanitary requirements in the area. To date, apparently no action has been taken regarding this matter and it is our opinion that the Department of Agriculture is vulnerable to severe criticism for not providing these needed facilities.

Parasitology Laboratory

The internationally famous Index and Catalogue of Medical and Veterinary Zoology, as well as a large collection of valuable specimens, is in our opinion insecurely maintained at Beltsville. If this material were lost it would be difficult and, in some cases, impossible to replace -- especially specimens which are so very valuable for reference purposes. We again recommend that steps be taken to provide fireproof storage for this material as soon as possible.

Many parasites cause diseases and conditions in animals that adversely affect the economic production of livestock as well as poultry and these must be studied more aggressively. Expanded facilities are needed for such studies to accommodate the scientists and equipment. Because other scientific and related agencies are located in the Beltsville-Washington area, we believe that such improvements and expansion should be made at Beltsville and recommend that appropriate plans be made at an early date.

Dairy Products Research Laboratory

Last year the Committee recommended the study of the establishment of a national research center for the development of new dairy products. In view of the increasing competition of imitation milks and the declining consumption of some dairy products, the Committee emphasizes the recommendation made a year ago. In order to continue the ongoing program of the Department and to avoid dislocation and loss of personnel due to abrupt moves, plans for an adequate facility should be developed in an organized manner and with deliberate speed.

U. S. Meat Animal Research Center, Clay Center, Nebraska

The Committee is concerned about the delays occasioned by the holdup of funds appropriated for Phase I construction of facilities at the U. S. Meat Animal Research Center located at Clay Center, Nebraska. This facility needs to be put into full operation as soon as possible. The beef, sheep, and swine research planned for this center is of a top priority nature. This is particularly important due to the time lag involved in breeding large animals. As was pointed out in our report last year, the planned scale of operations and specialized facilities will permit investigations which heretofore have not been possible at other locations. The facility and land resources are being developed to support and complement the total Federal-State meat animal research program. On the basis of conservative estimates, knowledge gained from this research could easily save \$500 million annually in the production of the U. S. meat supply or the equivalent of more than 20¢ per pound of beef in consumer's prices.

North Central Dairy Cattle Forage Utilization Laboratory

The Committee is pleased that a feasibility study has been made this past year. The Committee is anxious to see this project pushed to completion. Dairymen need every possible efficiency to make their profits greater. Producers are to a large extent unable to control the prices they pay for grains fed to their cattle just as they are unable to control the prices received for the milk they produce. Production of forage required by their cattle is an aspect of production offering the greatest potential improvement of future profits for dairymen. Lower production costs could increase profits to dairymen at no additional costs to consumers. Additional information is needed on forage technology, relationship of forage to concentrates, preservation efficiency, harvesting and handling procedures. The proposed Forage Utilization Laboratory, with its interdisciplinary approach to better forage utilization, should provide needed answers in this field. A team approach of agronomists, agricultural engineers, dairy husbandmen, nutritionists, and chemists would be most fruitful. Forage utilization, in the broad sense, involves the interaction of plant growth, harvesting procedures, storage facilities, treatments, and animal nutrition. A facility to implement simultaneous and coordinated studies of all aspects of forage utilization is urgently needed.

National Animal Disease Laboratory - Ames, Iowa

The crowded and limited space for important animal disease research activities at the National Animal Disease Laboratory prevents expanding or intensification of the work on several diseases of livestock and poultry mentioned in the "Animal Health" section of this report. In addition, we believe that attention should also be given to the effect that stress and environment may have on animals in relation to disease and that modified or more sophisticated facilities are urgently needed, especially for studies in cattle.

The release of space in the National Animal Disease Laboratory now occupied by personnel of the Animal Health Division and the Veterinary Biologics Division, ARS, would help to alleviate some of the space problems. We believe that separate facilities for this much needed and most useful work carried out by the Animal Health Division and the Veterinary Biologics Division should be provided or additions made to NADL at an early date. This matter was the subject of a special study group and reported in 1966 to the Department of Agriculture and we would urge that serious attention be given to it.

Plum Island Disease Laboratory

The problems related to the many and serious exotic diseases among animals and the great hazard to our livestock industry in this day and age, especially as related to extensive international travel and trade, warrants expansion of the work being conducted here. The recent disastrous outbreak of foot-and-mouth disease in Great Britain is an example and cause for great concern among livestock producers in the United States.

Improved and extended diagnostic facilities especially space, equipment, and personnel dealing with exotic diseases are urgently needed.

In addition to these recommendations, we believe it is highly desirable that pilot batches of foot-and-mouth disease vaccine be produced, adequately field tested, and a protocol be prepared for emergency use, if needed.

Animal Disease Research Laboratory - Denver, Colorado

During the past few years a small group of scientists at the Denver laboratory has made significant discoveries regarding the problem of bluetongue in sheep and cattle. These findings emphasize the great need for much additional information, especially with respect to the ecology and vectors of the virus. Since there now is good evidence that cattle and possibly wild animals also may be involved, it is most important that this work be expanded as rapidly as possible. In view of these problems, and especially since cattle are also involved, additional facilities are urgently needed. We recommend that arrangements be made to provide the same.

Prompt Action needed at Miles City, Montana

It is recommended that the laboratory office facility at Miles City, Montana, be completed at the earliest possible date in order to facilitate the beef cattle reproduction studies in progress at that location. Committee members familiar with the facilities at Miles City call them a "firetrap" and totally inadequate. If the competent researchers working there are to be retained, action to provide the new quarters for which money has been appropriated must be expedited.

Remodeling at Fort Reno, Oklahoma

Beef cattle, sheep, and swine nutrition, physiology of reproduction, and other needed research is being done at Fort Reno, Oklahoma. Space is needed for laboratories, offices, and animal research housing. Remodeling of an existing unused hospital building can be done at an estimated cost of \$200,000. For this sum a facility which new would cost \$1,200,000 can be provided and seems far more economical and practical than trying to expand the program in any other way.

New Poultry Facilities

The Committee is disturbed by the prolonged delays in initiation of construction of new laboratory facilities at East Lansing, Michigan, and Georgetown, Delaware. Money was appropriated for construction of these laboratories in 1963 and 1966, respectively, yet contracts have not been signed for construction at either location. Costs of construction continue to increase sharply each year thus materially reducing the value of the funds so appropriated and not promptly utilized. For example, \$450,000 appropriated for construction at East Lansing in 1963, an amount which might have been adequate at that time, will certainly be far less than adequate for construction of the necessary facilities six years later. The Committee strongly urges the administrators responsible for the expenditure of these funds to proceed promptly with the negotiation and construction of these facilities.

Woolen System - Albany, California

The Committee is pleased that plans have been developed along with preliminary estimates for the facilities required for woolen system processing at Albany, California. Such facilities will enable Department scientists to take advantage of wide opportunities, including durable press, which have been opened for wool. Such facilities for research on wool and mohair are presently not available in the wool and mohair industry. Present Department facilities at Albany are limited to the worsted system. The lack of the woolen system at Albany limits progress in research toward superior durable press wool and mohair products and other products made from variously modified wools and mohair. The manufacture of woolen fabrics presents unique problems in blending, carding, spinning, and finishing which are not receiving attention at present. Moreover, the woolen system of manufacturing consumes a greater proportion of domestic wools. The woolen system of processing is simpler and less expensive than the worsted system but, at present, it is adapted chiefly to making heavier weight fabrics whereas the modern trends are toward the lighter weights. Research is urgently needed to develop the technology required to allow woolens to meet adequately the challenge of today's textile markets.

IV. ANIMAL HUSBANDRY AND LIVESTOCK ENGINEERING

A. Reproductive Performance

Dairy. Physiological and management research needs to be expanded. The means should be available for controlling reproduction in dairy cattle in such a way that the most efficient use of cattle would result. The physiological bases should be developed for reducing embryo mortality and minimizing fertilization failure and ovarian dysfunction. Complete control of estrous cyclic activity should be achieved and technological means should be developed for collecting and disseminating genetic material from the best of cows. Ability to control the sex of offspring would be a major step in utilizing the cattle population most efficiently.

Beef. In 1965 6.5 million beef cows failed to calve. Maintenance of these barren cows cost cattlemen an estimated \$526 million, equivalent to nearly 3¢ a pound of wholesale beef. Research, as proposed for the U. S. Meat Animal Research Center, Clay Center, Nebraska, on this problem should reduce these costs by one-third in ten year's time with resulting savings to the ultimate consumer of about \$175 million a year. This research includes expansion of the genetic, physiological, and management aspects that would improve efficiency of reproduction of females and males to solve this number one problem of cattlemen. Much more knowledge in physiological genetics in relation to reproduction, nutritional needs for optimum reproduction, and systems of breeding beef cattle is needed.

It is recommended that the Western Regional Breeding and Genetics Project be refinanced. The re-establishment of the Investigations Leader position is of critical importance. The project has been productive and the cooperative participation of the State Agricultural Experiment Stations has allowed a high return per Federal dollar invested. This type of research requires a consistent and long-term effort but the returns can well justify the investment.

Swine. Approximately 5% of the sows kept for breeding purposes are incapable of normal reproduction. An additional 15% that breed do not farrow. Fertilization failure and embryonic death loss reduces potential litter size from 15 eggs ovulated to less than 10 pigs born alive. The financial loss to producers from sow reproductive inefficiency exceeds \$125 million annually. Greater knowledge of basic swine biology and the response of breeding sows to environmental conditions is urgently needed.

Recent studies of human birth defects indicate that maternal environment is frequently responsible for imperfections of body form and function. Early swine studies that classified similar defects as genetic in origin are likely inaccurate. The occurrence of such defects in swine is recognized as cause for culling the sows and boars involved and, if not of genetic origin, imposes an unnecessary cost on genetic improvement efforts. Research to determine genetic and nongenetic causes of swine birth defects is desirable. Defects which are caused by identifiable treatments or conditions are potential means of charting developmental sequences.

Poultry. Infertility and poor hatchability of broiler breeder and turkey eggs continue to be major problems of the poultry industry. Increases in egg production of turkey hens and broiler parent stock will contribute greatly to reducing production costs.

Research should be continued and expanded on methods of improving the fertility and hatchability of eggs and the egg production of broiler hens and turkeys. The problem should be approached through well-coordinated studies in genetics, physiology, nutrition, management, disease control, and environment. Investigations on physiological factors affecting practical diluents and semen storage should be included.

Egg shell quality must be improved in order to reduce losses in market and hatching eggs. Breakage results in loss of the thin shelled egg itself and contamination of other eggs in the nest or container. Basic and applied research is needed to increase shell strength and/or shell thickness. Relating shell strength to the microscopic structure of the shell may be one approach.

Sheep. Numbers of lambs produced per 100 ewes have not increased in the U. S. in the last eleven years. Acceleration of research in this field is needed to increase lamb production per ewe and per year, hopefully to a level of two lambings per ewe per year. Sheep need to be developed which will breed at any time of the year and which will produce more lambs per birth. Methods are needed to successfully induce estrus and ovulation and to control ovulation rate. The ability to identify multiple lambing will improve the management of sheep and the life expectancy of the lambs and also help producers segregate and care for ewes more properly. A satisfactory method of storing frozen ram semen for artificial insemination is needed. Additional work needs to be done on breeding efficiency in rams. Efforts should be made to develop techniques to control sex.

Goats. Additional research is needed to improve the reproductive rate of the Angora goat.

Fur Animals. Research is needed on the effects of light and hormones in controlling ovulation, implantation, and prenatal mortality and especially to determine if more than one reproductive cycle per year can be obtained to realize optimum reproductive capability of mink and other fur animals.

B. Feed Efficiency

Dairy. Recent trends toward higher levels of grain feeding have been instrumental in increasing milk yields per cow. However, this approach results in a very close association between profitability and grain-milk price ratios. Studies of forage technology are needed to gain knowledge on the extent that the forage portion of the ration can assume greater importance so that grain requirements could be reduced thereby reducing production costs.

Proportionately less forage is used in dairy rations now than ten years ago. This has come about because improvements in forage production technology have not kept pace with the advances in feed grain production. The untapped potential for improvements in forage quality and reductions in cost represent a major challenge to research and a major cost reduction opportunity for dairymen.

The growth of dairy heifers fed unwilted silages has been improved by treating the silage with 0.5% formic acid. This effect has been consistent in five trials. Studies are needed on the optimum treatment rates for different crops and the mechanism of the effect. The full development of this and other chemical treatments for improving the feeding value of forages would be of great value, particularly in the area of utilizing crop residues. Millions of tons of these residues could be made useful for some type of feeding by increasing digestibility and palatability by relatively modest amounts.

All-in-one feed mixtures for group feeding have been studied as a means of reducing the labor of individual feeding commonly practiced. A mixture of corn silage and about 15% concentrate has been satisfactory as a production ration. Research is needed to define the limitations for grain and forage mixtures as related to the forage used, stage of lactation of the cattle, and ration economy in order to obtain maximum benefit from this group feeding method.

Optimum use and combination of ration components both from forages and concentrates depends on adequate basic knowledge of the function of the digestive tract. Studies are needed on the rate and extent of digestion, metabolic products of digestion, and the rate of passage through the digestive tract. A few forages prepared by several different mechanical treatments have been studied in this manner. Generally, finer grinding has resulted in a lowered digestibility but an improved animal performance because of increased intakes. The data suggest, however, that an optimum mechanical preparation could be achieved which would increase the intake but with very little reduction in digestibility. Studies are needed on the relationships between particle size or other mechanical preparation and utilization of different forages and crop residues to determine the greatest possible benefit from this approach.

Beef. If the feed efficiency were to be increased only 10%, an annual saving approximating \$252 million could be made in the cost of beef production. This may be attained by expanding genetic research in this field and by fundamental research of ruminant nutrition emphasizing utilization of urea and other non-protein nitrogen sources and their relationship to fat in the ration. As protein sources become more and more expensive, expanding research into improved roughage utilization becomes more urgent.

Fundamental research is needed to determine the mechanisms whereby various hormones and hormonelike compounds improve animal performance and the interactions of these materials with different nutrients. At the present time, these compounds are being widely used in beef cattle feeding programs yet very little is known of their mode of action in the animal body. A knowledge

or understanding of mode of action could be immensely valuable in developing new compounds of greater effectiveness but with minimum side effects and residue problems.

Expanded research is needed on nutrition and feeding methods to be followed with heifers to increase the rate of gain in finishing. It is recommended that beef cattle program support be established for basic forage utilization studies at Beltsville. Such a program would serve as the nucleus for eventual range and pasture utilization studies throughout the country.

Swine. Additional research is needed to specify the nutrient requirements of newborn pigs and to assure the survival and efficient growth of early weaned pigs. The nutrient requirements for maximum ovulation rate in young females for maximum embryonic survival at the critical implantation stage of gestation and for sow conditioning at parturition require further research.

Alternative sources of nutrients, particularly protein sources that provide suitable levels of lysine and tryptophan, the limiting amino acids in swine feedstuffs need further evaluation in anticipation of increased competition for existing supplies by humans.

The opportunities for increased feed efficiency resulting from genetic improvement that lowers carcass fat percentage and increases growth rate thus reducing energy supplies needed for maintenance of body functions requires further investigation.

Recent genetic changes associated with the development of meatier hogs suggest the importance of revaluation of nutrient needs and feedstuff supplies to describe optimal feeding practices. Additional research is needed on the nutritional requirements at all stages of the life cycle and precise information about the biological value of alternate feedstuffs.

Sheep. It has been estimated that it takes 9 or 10 pounds of feed to produce a pound of lamb. Recent results indicate that feed conversion can be reduced to about 3 pounds of feed. Additional research is needed to determine how to obtain more pounds of gain per pound of feed as well as more pounds of red meat per pound of feed. Specific information is needed on more efficient rations for lambs on drylots, for supplementing pastures and ranges, and for each phase of reproduction and growth under intensive production.

Dairy Goats. These animals have the potential to produce large quantities of milk per animal where feedstuffs are scarce. Research in all areas of nutrient requirements of goats is needed to utilize this potential.

C. Environmental Stress in Production

Dairy. Research is needed to develop ways to improve the production and efficiency of milk cows and quality milk under environmental stress and when managed in large numbers. Effort should be given to physiological, genetic and feed intake stress and limitations at high levels of production, recommended management systems in extreme temperatures and climatic conditions and the adaptability of individual cows to group feeding and husbandry systems.

Beef. A number of factors cause stress in beef cattle production: (1) wide climatic conditions exist among beef-producing areas; (2) rapid, extensive transit of cattle in today's distribution system results in feeders being finished in environments strikingly different from that in which they were produced; (3) there is limited data on absolute effects of cold temperatures, humidity, and other factors on productivity; (4) environmental temperatures above 75-80 degrees are known to have deleterious effects on productivity of European-type cattle. Zebu-type cattle can withstand temperatures 5 to 10 degrees higher before production losses occur. The extent to which cattle can compensate for a period of high temperature during a subsequent period at lower temperatures is not known. (5) Little is known about the limits of genetic adaptability of today's beef cattle or the influence of this factor on the economics of the industry.

There is need to develop methods of producing beef that would minimize economic losses in productivity due to stress of climate, handling, and other environmental causes. Research emphasis needs to be given to: (1) development and evaluation of animal management handling and transportation systems that minimize stress and resulting shrinkage, (2) development and evaluation of specialized facilities and equipment that minimize the effects of stress on the efficiency of beef production, (3) identification of quantitative effects of environmental factors influencing beef production, (4) identification of genetic-environmental interactions influencing beef production, and (5) identification of mechanisms influencing genetic adaptation to environmental influences.

The success of research on these problems could decrease weight and death losses in movement of cattle from ranch to feedlot, strains of cattle could be developed that would be less affected by environmental stresses, beef production would approach the level more closely associated with the genetic potential, and lower production costs and improved enterprise efficiency should occur. A reasonable expectation of 6% gain in efficiency of gain on the 20 million head of cattle finished annually in feedlots at an average cost of approximately \$100 would amount to a national saving of \$120 million. In addition, there could be savings in labor and facility costs due to fewer days in the feedlot. A reduction of 15 days at 12¢ per day for 20 million head would amount to \$36 million.

Swine. Research is needed to identify the conditions of housing, ventilation, and waste removal that minimize environmental stress. Swine producers that finish hogs in confinement report an increased death loss among pigs loaded and transported to market. The possible relationship of meatiness and loss susceptibility should be studied.

Sheep. No domestic breed of sheep is well-adapted to climatic conditions in the southeastern U. S. Forage production in this area offers an important potential for sheep production. Breeds or strains of sheep need to be developed that are adapted to hot, humid conditions, will resist internal parasites, and will reproduce well in such a climate. Research is needed to determine the interrelationships of climatic factors with growth and reproduction.

Angora Goats. Improved management factors are needed for more efficient production of Angora goats. Methods should be developed to safeguard the freshly shorn goat when exposed to low temperatures, wind, and rainfall.

Laboratory Animals. Standards should be developed for optimum environmental conditions for the well-being of laboratory animals.

D. Production Management Systems

Dairy. Farm records are a must on our dairy farms today. Production efficiency and net incomes of producers could be improved by developing dairy farm records as a management planning aid by (1) expanding the scope of dairy production records to include physical quantities and dollar costs of production inputs for the whole farm as well as the dairy enterprise, and (2) developing procedures for using dairy production and feed records as a basis for determining the most profitable composition and amount of grain and forage to feed. Research on record performances is needed to accelerate genetic progress through mass selection.

Recent progress is indicated in the more accurate and complete USDA-DHIA sire evaluation procedures that were put into effect in 1967. Among the new procedures adopted were improved age adjustment factors and a method of adjusting summaries for nongenetic differences between bulls arising from the number of herds in which their progeny were located. Revisions in electronic computer methods have also reduced delays in supplying the sire summaries to the dairy industry from a month to a few days. It is believed that the accuracy of identifying bulls having superior genetic merit has increased 5% to 10% by adoption of the new procedures.

As a result of these revisions and improvements, all segments of the dairy industry including Purebred Dairy Cattle Breed Associations, National Assn. of Animal Breeders, and others are for the first time united and using the DHIA sire summary as the only official evaluation.

Alternative methods of DHIA testing such as combinations of independent tests and farmer recording as practiced in Europe, different lengths of test interval, use of bulk-tank weights as a control on farmer recording, have not been precisely evaluated under American conditions. There have been basically no changes in on-the-farm sampling procedures for thirty years. One limitation of the DHIA program may be the lack of useful alternative procedures.

One of the most perplexing questions in dairying is why only 23% of dairymen in the U. S. participate in the DHIA recordkeeping programs. Studies are needed to show how much an individual herd owner can benefit economically from participating in DHIA. Also, critical research is needed to determine whether data now obtained in DHIA are really those needed under modern economic conditions. Such a study would need to cover several States and be a cooperative or contract project with several State Universities but coordinated by USDA.

Some progress is being made toward improved forage utilization. It has been found, for example, that the harvesting losses associated with wilting of crops prior to ensiling can be kept below 5% by wilting in a windrow without further handling. The specific influences of crop, yield, weather, and the extent of wilting on these losses under this particular procedure should be further investigated.

Studies on the preservation efficiency in low-cost silos such as bunkers and stacks have been made. Also, various sealing procedures have been evaluated. It is possible to achieve about 90% preservation of most crops in bunkers with the sealing procedures developed. The next step needed is research on improved methods of filling and feeding from such structures as well as the development of other sealing methods.

Beef. Labor requirements for beef production average about 12 hours per \$100 of product, lower than for any animal type except broilers for which the requirement is about 6 hours. Despite the relatively favorable showing, beef producers are concerned with the failure of their industry to improve as rapidly in labor efficiency as others. Total investment per breeding cow in commercial herds has been increasing for many years and ranges from \$600-\$1500. Investment per head in feedlot finishing facilities varies from \$125-\$250 in Midwest farmer-feeder units. Costs in areas not requiring housing average about \$80-\$90 nationally. Labor and fixed costs represent an important portion of total beef production costs. Opportunities for reduction appear to exist in increased automation and development of complete systems-engineered procedures.

Research is needed to plan, develop, and field-test beef production management systems that maximize the yield of desirable beef per animal from a minimum input of land, labor, and capital.

This research should be directed at: (1) reducing the per unit requirements of labor, equipment, facilities, and land through application of the systems principle; (2) developing improved methods of farm handling, processing, and storing feeds; (3) increasing land returns through correlated crops, pasture, and cattle management systems; (4) combining biological, economic, and physical data into improved tools for decision-making; (5) developing greater labor efficiency through systems engineering; and (6) developing methods for elimination of hazards and drudgery from beef production.

Swine. Rising land values and labor costs are causing producers to adopt confinement farrowing and finishing systems and to develop larger, specialized hog production facilities that represent substantial investments in equipment and buildings. Swine producers urgently need research to determine the relationship of production efficiency and types and location of feed supply, markets, size of production units, and production technology. Problems of waste disposal, including possible salvage, are increasingly important and require investigation.

Breeding and genetic research on the unique problems of swine is needed to speed the development of more effective practices in swine breeding. Rates of genetic improvement in economic value exceeding 2% per year have been demonstrated under limited and specialized conditions of selection. Research on techniques to extend this effort to a larger segment of the swine industry is urgently needed.

Swine breeding research should be expanded in detecting protein polymorphism in serum, milk, and other body fluids. Studies with laboratory animals and swine are needed to determine the relationship of the protein polymorphisms to economic traits of swine production. The proteins involved should be characterized and related to pedigree data in order to determine the type of genetic control involved. This information could identify swine seedstock possessing superior performance capabilities and lead to the development of more effective swine breeding selection programs.

The genetic and breeding research on single traits of major economic value should be accelerated and expanded to permit investigation of more traits, the interrelationships among important traits, and the identification of interactions with environmental factors. Seasonal differences in production efficiency are recognized for reproductive performance, feed utilization, and carcass desirability. Clarification and development of methods for the exploitation of such relationships would accomplish substantial reductions in production cost and, at the same time, improve consumer acceptability of pork. Research is urgently needed.

The relationships of breeding, housing, and management practices to reproductive efficiency in sows should be investigated to determine practical systems for improving reproductive output. U. S. sow herds average not more than 15 pigs raised per sow per year even though individual herds frequently exceed this performance by 30%. Investigations that attack the whole scope of swine production in single units are needed to solidify desirable practices into a coherent system capable of demonstrating management practices.

Leg weaknesses of confinement-raised swine reduce the performance of market hogs and restricts the opportunity for selection among potential replacement gilts. Studies should be undertaken to identify the nutritive, genetic or mechanical cause of such interferences.

A better system of animal identification prior to marketing and slaughter is currently needed by the pork industry. This identification would be a valuable adjunct to disease eradication programs. Present identification methods are cumbersome and expensive.

Fundamental information in the areas of waste disposal, environmental control, labor efficiency, facilities and equipment design is essential to the development of practical swine confinement systems. Greater concentrations of pigs in confinement systems will create new problems. An expanded research effort aimed at defining and solving such production problems is critically needed.

Poultry. Downgrading due to breast blisters and bruising represents a tremendous loss in broilers, roasters, and turkeys. As a rule of thumb, 10% downgrade is about equal to 1% condemnation in broilers and costs the broiler industry more than \$3 million annually. Increased basic and applied research is needed on this problem.

Management and environmental factors, genetics, disease conditions, catching, loading, hauling, handling, and processing procedures all need careful study in an effort to determine new ways to minimize these losses.

Sheep. Expand research on intensive lamb production to develop practical systems of intensive management under various degrees of confinement. These systems would involve maximum use of gains from other research proposals to encourage large, specialized units with greatly increased efficiency. New investigations are needed on breeding, feeding, and management practices to permit highly intensive production of lambs at all seasons of the year. This would include development of equipment and housing to reduce man-hours of labor required.

A national sheep improvement plan should be initiated to include research on implementation, development, and improvement of a nationwide performance and progeny recording system to increase the production and quality of lamb meat and wool. The Sheep Industry Development Program is a beginning in this field and should be continued and augmented. Such a system would lead to the genetic improvement of lamb production, growth rates, carcass merit, wool weights, and wool quality. This plan should be backed up with more adequate estimates of heritability of each trait which is important to the sheep production.

Continued research on breeding systems and crossbreeding is recommended at Beltsville. Different exotic breeds from foreign countries should be incorporated into the crossbreeding program. The question to be answered is whether or not these imported animals can be used effectively.

Lambs are being weaned at increased weights. Further research is needed to increase rate of gain so that lambs can be marketed at younger ages. Management and feeding systems need to be developed for feeders to prevent continued market gluts of overfat lambs.

Shearing is a difficult and expensive task and a product should be developed to simplify this task. The animals could be sprayed, fed, injected, or otherwise treated so that the wool could be plucked.

Goats. Additional research is needed to develop and improve Angora goat production and management practices.

Rabbits. Research on domestic rabbit production should be undertaken to improve meat and fur, control seasonal anestrus, and improve management practices.

Horses. Increased use of horses for recreational purposes has created a demand for information on care, feeding, and management of horses which is not available. Research should be initiated on these problems.

Fur Animals. Research is needed to develop management methods to prevent the "wet belly" condition in mink.

E. Production of Animal Products with Improved Consumer Acceptability

Sheep. The sheep industry has identified what it terms a "Consumer Preferred Lamb." Progress has been made in determining actual cut-out values of these lamb carcasses and their relationship to the live lamb but further research is needed to refine and place into commercial practice the results of the progress already made.

F. Protection of Food from Harmful Micro-organisms and Toxins

Salmonella contamination of poultry products continues to grow as a major concern of the industry, especially with the increased emphasis by the Food and Drug Administration on protection of the consumer from contaminated food-stuffs.

Research is needed to develop a quick method of detecting salmonella and identifying pathogenic types. Research is also needed to develop easy and practical methods of killing salmonella found in feed ingredients or finished feeds before delivery to poultry farms as well as controlling or destroying pathogens in hatchery operations and on poultry farms.

G. Protect Livestock and Poultry from Toxic Chemicals, Poisonous Plants, and other Hazards

Sheep and Goats. Research is needed to determine if herbicides used in range plant and brush control are harmful to sheep and goats when ingested over long periods of time.

Fur Animals. Investigations are needed on the effect of pesticides which may be present in poultry offal or in fish or mink.

Hormones and chemicals used in feeds for poultry or other farm animals, with resulting residues in wastes and byproducts, are a constant threat to the well-being of mink which are fed their offal. Additional research is needed to prevent losses from these materials.

H. Alleviate Soil, Water, and Air Pollution

Beef. Several States have laws regulating feedyards because of pollution. Extensive research is needed to find new and better ways to dispose of feed-yard wastes, including the possibility of developing new products from the wastes.

Sheep. Sheep maintained on slatted floors for intensive production accumulate semisolid wastes in a form unique to this species. Efficient methods are needed for converting this waste to a marketable product or for disposing of it in an aesthetic and safe manner. Research is needed on control of odors; on changes of waste in storage, soil, and water; and on the physical, chemical, and biological properties of such wastes.

Goats. Dairy goats which are usually kept near large cities offer an opportunity for appraising effects of air pollution. Research should be initiated to determine the effects of common air pollutants on the respiratory tract and the physiology of the goat.

V. ANIMAL HEALTH

A. Diseases of Livestock and Poultry

In the "National Program of Research for Agriculture" a set of broad national goals was developed. In order to carry out research aimed at helping to achieve a particular goal it was necessary to establish manageable subareas. These have been defined as "problem areas" of which there are ninety-one. The subcommittee on Animal Health thought their recommendations would be more meaningful if set against the backdrop of the national problem area which follows:

"Infectious diseases represent the single greatest hazard to the production of an adequate and wholesome supply of animal protein. They are a constant threat to the livestock or poultry producer who can be wiped out of business by a catastrophic disease outbreak. This hazard increases as the prevalence and severity of a disease increases. The total losses to the public from animal diseases will exceed \$2.6 billion annually by 1980 if continued at the present rates. Losses result from mortality, reduced productivity, cost of treatment or immunizations, cost of regulatory programs, and condemnations of meat at the slaughterhouse. Some diseases which cause losses in animals are also transmissible to man."

On the basis of this overall activation, the Committee makes the following recommendations:

Cattle:

Mastitis is the most serious animal health problem of the dairy industry, costing dairymen an estimated half-billion dollars a year. Mastitis and abnormal milk, as judged by high leukocyte count, are tied together in the eyes of many. The surveillance and control program scheduled for implementation on July 1, 1970, may impose severe economic hardships on producers. Information on how to cope with this problem is urgently needed. Although there has been some increase in research activity, there is need for much additional work. The condition must be approached at the multidiscipline level. Also, additional study is needed on the evaluation of the leukocyte determination as applied to market milk to validate an indication of mastitis and its possible use in herd management studies.

There are three aspects of the problem:

1. Mastitis - the disease
2. Abnormal milk attributed to mastitis
3. Protection of the public milk supply

In order to focus on the basic problem, "mastitis" must be defined as inflammation of the mammary gland resulting from a microbial infection. Mastitis research is concerned with determining the factors that contribute to susceptibility to infection and developing corrective methods to materially reduce the incidence of disease. Although we have very little specific proof, present knowledge strongly suggests that susceptibility of the mammary gland to infection is influenced by the animal's environment, management, physiology, and genetic composition. The difficulty in identifying these contributing factors and tracing their function stems from the complexity of the disease. Numerous studies have yielded conflicting results and contradictory conclusions. Additional research is needed to clarify this uncertain situation.

The leukocyte count as an indicator of "abnormal milk" needs further clarification. Leukocytes are one of the major defense mechanisms of the animal's body. Their rapid influx in response to invading organisms serves as an indicator of mastitis. Studies have shown that there are large variations in cell counts of normal milk from uninfected quarters, between cows and quarters of the same cow, between samples taken from the same quarter at different times of day or even at different points in the normal milking process. This degree of normal variability makes it impossible to establish a cell count capable of differentiating with high accuracy between infected and uninfected quarters. Continued studies are needed concerning the role of leukocytes in the body's defense and the determination of specific factors relating to susceptibility to infection.

The current "abnormal milk control programs" were developed to guard the fluid milk supply against contamination with mastitic secretion. These programs are based on the assumption that cell counts above a specified control level in bulk shipment are evidence that the dairyman has incorporated mastitic milk in his supply. The success of these programs will depend on the development of a reliable counting procedure and screening test, the establishment of realistic control limits and the development of effective means of reducing the incidence of mastitis in the dairy herd. The present control level of 1.5 million per milliliter for bulk milk, set by the National Conference on Interstate Milk Shipments, appears to be a realistic starting point. However, some States are pushing ahead with lower limits that may prove detrimental to the dairy industry and the consumer. As part of the program of the National Mastitis Council's Research Subcommittee on Screening Tests, investigations at Beltsville on cell counting procedures and screening tests need to be continued.

Negotiations are in progress for an evaluation of the control program in two areas of the country. These studies will provide necessary information on the utility of bulk milk cell counts as an index of udder infection and on

the effectiveness of current recommendations in reducing the incidence of abnormal milk. Additional research concerning the factors affecting cell count in healthy cows is urgently needed for the establishment of realistic control limits. These must operate to prevent the sale of mastitic milk without penalizing the dairymen for cell count changes resulting from normal sources of variation in healthy well-managed cows.

Bluetongue, a disease of cattle and sheep, is growing in significance in cattle. While research has been expanded, there is need for much additional information to provide diagnostic methods and immunizing agents.

The Respiratory Disease Complex is still a serious and widespread cause of loss through morbidity and mortality. It is very complicated and requires a concerted effort including disease control, management, nutrition, genetics, physical handling, facilities, and transportation.

Calf Scours cause high mortality in calves under six months of age. The Department is to be commended for extension and coordination of research at State Experiment Stations and it is recommended that the work be continued.

Pinkeye (Infectious-Kerato-Conjunctivitis) is responsible for heavy losses in meat and milk production. The need to identify all of the causative agents and to develop effective therapeutic agents are justification for additional research.

Vibriosis is still a serious cause of abortions and impaired fertility, especially in beef cattle. Development of a bacterin, which is proving effective, is a major breakthrough. Improved diagnostic methods are still needed.

Leptospirosis, which affects several other animal species and man, is still a serious problem. Recognition of many serotypes of the organism makes it a difficult disease to control. Research is still needed to determine all of the serotypes that infect cattle and to develop effective immunizing agents.

Foot Rot still results in great losses in weight and in milk production. The causative agents are not known. The Department is commended for expanding research on the condition.

Bovine Lymphosarcoma (Leukosis), because of its possible public health significance and economic importance, justifies continued study on causative agents and means by which it spreads.

Foot-and-Mouth Disease and Other Exotic Diseases assume greater importance with the serious outbreak of foot-and-mouth disease in Great Britain and recovery of foot-and-mouth virus from the esophagus of apparently healthy cattle. Personnel and facilities must be expanded to permit production and testing on a pilot plant scale of immunizing agents against foot-and-mouth disease and the study of African horse sickness, African swine fever, rinderpest, bovine contagious pleuropneumonia, and other exotic diseases.

Tuberculosis and Paratuberculosis (Johne's Disease). There is still a need for the development of an accurate and specific diagnostic test for the diseases caused by the acid-fast group of bacteria.

Bloat, Grass Tetany, Milk Fever, and other Metabolic and Digestive Disturbances are responsible for serious economic losses. In spite of encouraging advances in controlling frothy bloat, feedlot bloat is still of major importance. Research should include intensive study of soil and forage crops.

Poultry:

The leukosis complex continues to be the most baffling and costly disease in poultry. During the past year, some significant findings regarding the etiology were announced independently by the Agricultural Research Service and British research workers. This is indeed encouraging information and perhaps the initial finding that will lead to methods and procedures to eradicate or prevent the infection in susceptible birds. The Committee is pleased with the arrangements that have been made to have scientists in several other locations cooperate in order to expand the effort in this area of research so vital to the poultry industry, particularly the emphasis on Marek's disease. The Committee urges ARS to recognize Marek's disease as the number one concern of the broiler- and pullet-growing industries today. Every effort and every dollar possible should be expended in the study of this rapidly growing problem. Wherever facilities and competent scientists are available for research on Marek's disease, they should be utilized, even at the expense of other avian disease research. Any delay in use of funds allotted to leukosis research is unthinkable. Likewise, the construction of facilities at East Lansing should be completed without delay. Especially should efforts be directed toward studies in transmission of the disease, control by vaccination or drugs, and eradication by breeding or other means. Also, attention should be given to identification of various forms of the disease, especially skin leukosis, and criteria developed to differentiate skin leukosis from other skin disorders. At present, the Inspection Service of the Consumer and Marketing Service is under heavy attack for condemning birds for skin leukosis, many of which possibly have no leukosis disease whatever. Adequate research by qualified scientists in USDA or at State Universities or Experiment Stations should be able to develop adequate criteria for use by the Inspection Service.

Mycoplasmosis (PPLO). Mycoplasma infection in poultry is recognized as a serious problem and especially as it is involved in the syndrome referred to as air sacculitis (chronic respiratory disease). The latter is responsible for a high percentage of condemnations of many broiler birds. During the past year, some progress was made in a procedure to treat hatching eggs that may be an effective and practical method for preventing infection in chicks. This finding is encouraging, therefore we strongly urge expanded research on this problem to determine methods for the eradication or control of the disease.

Fowl Cholera (Pasteurellosis). This disease is recognized as being responsible for significant losses to the turkey industry. In view of the lack of effective methods for the prevention or effective methods for control of this disease, we recommend that research be initiated or supported in outside laboratories.

Blue Comb. This ill-defined disease condition found in maturing turkeys apparently is causing serious morbidity and mortality in some areas of the country. We strongly urge that increased effort be made to determine the etiology of the disease as well as develop methods and procedures for its control.

Salmonella. Salmonella infections in poultry and poultry products continue to be a serious problem for the industry. We are pleased to learn that progress is being made with respect to fundamental knowledge regarding egg infection and also effective methods for processing egg products to eliminate virulent salmonella organisms. We recommend that this work be continued in order to develop methods to assure freedom from salmonella infection of poultry and poultry products.

Gumboro Disease (Avian Nephrosis). This disease is recognized as a serious problem in chickens in some parts of the country and we recommend the initiation of studies to determine the etiology and methods for its control.

Coccidiosis. This protozoan disease, caused by a number of pathogenic strains of organisms, continues to be responsible for serious morbidity and mortality in poultry in some producing areas despite the widespread use of chemical and biological agents. The development of resistance to these agents may partially be responsible for some of the problems. Another aspect of the situation is that, although coccidiostats are available for reasonable control of coccidiosis in poultry and new ones are continually being developed, the use of these products represents a tremendous cost item in broiler, turkey, and pullet production. Because the coccidiostats are developed by pharmaceutical companies, no one can expect them to develop a program which will eliminate the use of drugs. Research is needed to develop a control program which would eliminate this constant use of coccidiostats.

Hemorrhagic Enteritis. Enteritis in turkeys continues to be a serious problem in some parts of the country. This disease entity is not well understood with respect to the etiology. We recommend that basic research be initiated to determine the cause and methods for control of the disease.

Swine:

One of the most critical needs in continuing to develop a more efficient pork industry lies in the area of animal health.

Hog Cholera. Additional research is still needed in diagnostic methods, identification of virus strains, and complicated infections in hog cholera.

Brucellosis. Work on brucellosis is of sufficient importance to be continued and accelerated.

Abscesses in the neck, jowl, and other parts of the body constitute enormous annual losses. Research in this area should be expanded and expedited.

Reproductive Diseases -- The Mastitis-Metritis Complex has become more prevalent in recent years, especially where swine production is extensive and farrowing confinement rearing is practiced. Losses may be through death of fertilized ova, death of baby pigs, and milk failure in sows. There is need for continued research in connection with this condition.

Respiratory Diseases, which include virus pneumonia, influenza, and pasteurellosis, need further investigation. Confinement rearing makes these diseases increasingly important problems.

Sheep, Goats, and Other Animals (as they apply):

Epididymitis continues to be a frequent cause of sterility in rams. We recommend that studies be initiated to determine the cause, transmission, prevention, and possible eradication of this disease. Present serum is not effective.

Mastitis in lactating ewes is of serious concern to all sheep raisers. With the prospects of more intensive and improved breeding programs, including estrus synchronization and artificial insemination, there is a likelihood of a greater incidence of mastitis in ewes. Since very little is known about this disease in sheep in this country, it is recommended that research be started to determine methods for prevention and treatment.

Stiffness in Lambs. A condition of stiffness in lambs is not well understood presently and is of considerable expense to the growers of the country. Basic research is needed to determine the various causes of the condition and to develop methods for control or eradication of the problem.

Scrapie. Progress and significant contributions have been made by the U. S. scientists in obtaining a better understanding of this disease. While the incidence in sheep in this country is not extensive, the fact that it does exist and that no procedures are known for its prevention are justification that research be continued to gain useful information for management of this disease.

Vibriosis. This is a bacterial disease causing serious reproductive problems in many flocks. Research should be continued in order to better control and/or eradicate this disease.

Bluetongue. Continued and expanded research should be conducted on this disease as it relates to sheep and cattle. (Note recommendations under "Facilities - Denver Laboratory" and item under "Cattle Diseases.")

Foot Rot. Studies regarding the problem of foot rot in sheep have been started and should be continued in order to develop practical methods for prevention and control.

Urinary Calculi. This poorly understood clinical problem, possibly of a metabolic origin, is frequently encountered in range and feedlot sheep. Research is needed to develop an understanding of the problem and to develop procedures useful in prevention of it.

Rabbits:

Pasteurellosis (Snuffles) causes serious losses to the rabbit-raising industry. Acute and chronic forms of the disease are recognized. The problem is recognized among breeders engaged in the production of rabbits for meat and pelts as well as those who are producing rabbits for biomedical research studies. Because of the widespread and significant incidence of the disease, research should be initiated to develop methods for prevention and control. In addition, such studies may also serve as a model to better understand the respiratory disease complex referred to as "shipping fever" in cattle.

Horses:

Equine Piroplasmiasis, a protozoan disease that is transmitted by ticks, is under study. While some progress has been made, there is urgent need for more research on insect vectors, the character of the causative agent in the vectors, an immunizing product, and therapy of acute and carrier cases. A suitable experimental host animal is needed.

Equine Infectious Anemia is a virus disease transmitted by insects. A test for carrier animals has been developed but there is need for its refinement to permit greater accuracy; to find an acceptable experimental host, an immunizing agent, and therapeutic agents.

Reproductive Diseases are responsible for lowered conception rates in mares and death of foals. Research should be conducted on these problems.

Nutritional Diseases are responsible for apparent injury to bony structures of young horses. Only a limited amount of privately financed research is being done.

B. Parasites of Livestock and Poultry

For the reasons given at the beginning of the previous section, the "problem area" as stated in the "National Program of Research for Agriculture" is cited:

"Internal parasites, such as various kinds of worms, flukes, and coccidia, cause losses in all parts of the country and in all seasons. In general, warmth, moisture, and shade favor parasites. About 300 kinds are of economic importance in the United States and will cause losses estimated

at \$650 million annually by 1980 at present rates. Severe infestations of parasites may cause heavy direct losses to the livestock producer but internal parasites generally are unseen, their effects are not apparent, and the loss to the public from inefficient production is hidden. Losses include mortality, reduced yield, condemnation of meat, feed wastage, and cost of drugs. Even for the parasites that have been the subject of considerable research, treatment or control measures are far from adequate."

The following specific recommendations are made:

Gastrointestinal Parasites. Young animals are especially susceptible to the effects of internal parasites. Parasites also cause lowered efficiency of production in adult animals. There is need to study additional therapeutic agents, especially for tape worms and strongyloides. Research is needed to develop prophylactic agents as well as methods of treating large numbers of animals.

Lung Worms. Lung worm infections are serious problems in cattle, sheep, and swine. There are no effective methods for prevention or treatment at the present time.

Anaplasmosis continues to cause serious losses both in morbidity and mortality in cattle. More knowledge is needed about the transmission, especially by insect vectors. Some progress has been made regarding the prevention of the disease. Much remains to be learned about the use of vaccine for prevention as well as agents for treatment.

Liver Flukes. Liver flukes in sheep are a serious problem in some parts of the U. S. Much is known regarding the life cycle of these parasites, however, there is great need for information regarding prevention of the infection as well as better agents for use in the treatment of infected sheep and cattle.

Trichinosis continues to be a serious problem with respect to exportation of pork. Research should be continued and expanded.

Trichomoniasis, a protozoan disease of the reproductive tract, continues to be of economic importance in terms of impaired fertility and abortion in cattle. Additional research is needed on this problem.

Coccidiosis, a protozoan disease especially in poultry, is widespread in spite of the fact that new compounds and a vaccine have been developed. There is need for continued research to develop new and improved methods in the control of this disease. (See also reference under "Diseases of Poultry.")

C. Protection from Toxic Chemicals, Poisonous Plants, and Other Hazards

Continued research is needed on plants, chemicals, and radioactive toxic substances. Completion and staffing of the laboratory in Texas should be accelerated in connection with this program.

D. Livestock Insects and Other Arthropods

Greater emphasis should be given to insects associated with livestock and poultry diseases. It is urged that additional funds and facilities be made available for this program. Studies should include all aspects of the life cycle of the insects concerned with the transmission of diseases and the use of biological and chemical agents in the control of such insects.

Chiggers - Poultry Mites. This insect attacks poultry on the range, especially turkeys. It usually produces ulcerated lesions on the inside of the thighs and under the wings, which may result in downgrading of the carcass. There is an urgent need for research on the biology and practical methods for the control of the mite, Neoschönogastia Americana.

VI. UTILIZATION, NUTRITION AND CONSUMER USE

A. Utilization Research

This Committee recommends research which seeks to provide a useful base of fundamental information as a springboard for innovation to improve consumer satisfaction and protection and to meet changing social needs and economic demands.

Dairy Utilization:

Microbiological Studies. Research should be continued on processes for eliminating salmonella from dairy products. Also, research should be continued on bacterial spores to develop improved methods for destroying or inactivating them particularly in sterilized dairy products.

Whey. Expanded research is needed on whey utilization and waste disposal. New uses for whey, especially cottage cheese whey, need to be developed for use in food manufacture.

Cheese Research. Increased emphasis needs to be given to the development of improved efficiencies of cheese production by expanding basic and applied research on milk coagulation, curd formation, and more rapid flavor development.

Instant Dry Whole Milk. Significant advances have been made in the development of beverage quality dry whole milk and consumer studies are underway. The development of other dry milk products utilizing these principles is desirable.

Nonfat Dry Milk. Work should be expanded on the utilization of nonfat dry milk in the formulation of other foods, including standardization of the nonfat solids component in milk.

Milk Fat. Research is needed to develop new uses for milk fat and to improve dairy products containing milk fat, particularly to stabilize the flavor during storage of butteroil and products containing milk fat. Basic research is needed to uncover factors influencing the fat-protein relationships in the fat globule membrane so that the fat stability in dairy products may be controlled.

Legal Barriers. There is need to review and suggest methods for eliminating the legal barriers that retard or prevent manufacture and use of new and improved dairy products created by research. (See under "General Comments," In-depth Study of the Dairy Industry.)

Meat Utilization:

The Committee recommends continuation of the existing program and initiation of certain new or expanded research. Specifically:

New Research Related to Centralized Packaging. New research is needed to develop methods for producing carcass meat with low surface microbial loads. Such meats are needed if longer shelf life in packaged meats is to be achieved. Methods for pasteurizing or cleaning carcasses after evisceration and for preventing their recontamination must be developed. Cooperative research with other agencies of ARS should be planned to test such meats in distribution channels.

New Research on Meat Products. Work should be expanded on the detection and control of micro-organisms of public health significance such as staphylococci, salmonellae, and spore-forming micro-organisms in meats and meat products. Methods are needed which will preserve the naturally fine qualities of meat and meat products while assuring wholesomeness for institutional and home consumption.

Safeguarding Quality of Meat Products. Research to safeguard the quality of meat products should be expanded. The relationship of processing techniques to microbial growth encompasses numerous variables. Current studies represent only a fraction of the effort needed to provide basic information regarding micro-organisms that endanger products with widely different characteristics and components now being produced, shipped, and stored in everwidening market channels. Another phase of research should be devoted to studies of natural inhibitory substances in meat products and their effects on the viability, infectivity, toxigenicity, and pathogenicity of selected micro-organisms.

Chemical and Physical Composition of Meat. Detailed knowledge of the chemical composition and physical properties of meat are essential to the development of new or improved processed products and to the improvement of meat technology. Research should be continued on major and minor components, their structure and properties, and changes that occur during processing. A far more complete determination is needed on types of protein, protein level, and amino acid content for these raw materials, particularly the differences that may exist in different cuts of meat within the same carcass and from carcass to carcass within the same species.

Flavor Research. Investigations currently underway relating to the flavor of meat and meat products should be expanded. The chemical components which determine flavor and aroma are currently being determined. These studies should be extended to cured and processed meats in order to learn how original meat flavors are modified by processing. Similarly, the current work on smoke should be expanded to include studies on the reactions between smoke and meat components.

Poultry and Egg Utilization:

Chemical Composition and Physical Properties. The rapidly changing poultry industry makes important use of fundamental information of poultry and eggs. Recent findings on the interaction of egg proteins that are of potential practical significance emphasize the importance of fundamental studies. Basic studies of chromogenic proteins may lead to an understanding of sporadic occurrence of unnatural pink color in cooked products. Utilizing the most advanced scientific developments, research should be expanded on the composition and especially on the properties of components of poultry and eggs in order to provide a continuing sound basis for the development of new processes and products and for solving troublesome problems as they arise. The studies should include an evaluation of the influence of genetic, environmental, and nutritional variations on the useful properties of products.

New and Improved Poultry and Egg Utilization. Added values available in ready-to-serve poultry- and egg-containing products of high quality whether cooked, frozen, canned, or dried help to sell and increase the return realized from poultry and eggs. An expanded research program on the major factors influencing quality, stability, wholesomeness, and processing costs is needed to assure maximum return. The program should include only a limited effort on formulation. Major emphasis should be placed on developing principles of processing and storing that would be widely applicable in the production of superior poultry meat and egg products and on the development of products that would be useful in formulation of other foods including emulsifying and binding properties of component parts. Studies should include the influence of such factors as maturity, strain, sex, diet, and fat content on performance. Studies are needed to define in chemical and physical terms the texture and other quality changes in poultry meat caused by processing such as canning, dehydration, and irradiation as a basis for developing superior products that can reach markets with little or no special handling.

Processing Poultry for Optimum Tenderness. Under present continuous-line processing procedures, optimum tenderness does not develop in poultry meat. The alternative, the use of long-time tenderizing periods, is inconvenient and costly. Obvious variations in processing treatments have failed to eliminate the need to age several types of poultry. In view of encouraging basic observations, studies of tenderness should be accelerated. Emphasis should be given to studies of the mechanism of tenderization and to ways the knowledge gained can be applied. Methods should be sought for the early identification and treatment of the small but significant percentage of processed poultry meat that does not become tender as ordinarily aged and processed.

Flavor of Poultry Meat Products. Much of the frozen, dehydrated, or otherwise processed poultry has varied widely both in natural poultry flavor and in development of off-flavor. A great deal of knowledge has resulted from research on poultry flavors at the Western Utilization Laboratory. The studies should be expanded to apply this information, to develop additional information, especially to develop a more exact relation between specific poultry constituents and organoleptic response. A specific study should be made of the cause and character of "warmed over" and "off" flavors because of the increasing production of prepared poultry products.

Improvement of Salmonella Destruction Treatments. While successful pasteurization of egg products is being practiced commercially, further specific studies should be conducted to thoroughly evaluate important physiological and environmental factors that influence the resistance of salmonellae to destruction in order to develop milder and less costly pasteurization treatments for all types of egg products. The engineering aspects of egg product pasteurization need further study. It is urgent that research be conducted to develop improved pasteurization treatments for poultry products. For both poultry and eggs, studies are needed to determine the processing and control steps necessary to avoid cross contamination and postpasteurization contamination.

Nutritional Properties of Eggs. Comprehensive information should be developed on the nutritive properties of eggs including the significance of trace elements as affected by such factors as inheritance, diet, storage, handling, and processing.

Animal Fat Utilization:

Industrial Uses. Chemical derivatives research has been particularly effective in providing new markets for inedible fats of which 4.5 billion pounds per year are produced as a byproduct of the livestock industry. It is important, therefore, to emphasize further development of new chemicals useful in such large volume outlets as plastics, plasticizers, lubricants, lubricant additives, and biodegradable detergents. Development of fat-based detergents with their superior biodegradability would be an important contribution to the preservation of supplies of potable water. Research should be expanded to provide the information and background essential to development of new products for these market areas and public needs.

Food Uses. The marketing of a larger amount of U. S. animal fat as edible fat would increase the return to the livestock industry while adding to world food supplies. This objective can be achieved in part by so processing and handling animal fats as to permit production of a greater proportion of edible tallow. The gradual development of more centralized meat packaging will make its contribution to the change. However, the demand for edible fat should be increased by scientific progress in the areas of fat stability, mechanical or chemical blending and modification to produce food products with improved properties.

Wool and Mohair Utilization:

The Committee commends the significant progress made in the refinement and development of the Department's WURLAN treatment of wool for machine washability, and in the new opportunities now opened for superior durable press wool products, and in the new breakthrough in treating wool and mohair in corona (electrical discharge) fields. The Committee feels that this and related basic research needs strong support so that the fullest possible benefits from this work to our sheep industry can be realized. (See also the general recommendation on facilities for the woolen system.)

Durable Press Wools. The Committee strongly urges continued and accelerated research and development on durable press wool and mohair apparel through new and refined chemical treatments and through the scientific design of optimum woolen and worsted woven and knitted fabric constructions. The concept of durable press has been so well-established in other fibers that the consumers will expect wool to keep pace in the highly competitive textile field. Superior durable press wool and mohair apparel will not only provide significant savings to the consumer in upkeep costs but will also strengthen wool's overall competitive position.

Wool Composition and Physical Properties. The Committee urges expansion of basic research on wool and mohair composition, structure, stability, and modification in order to provide the background of information needed for future development of new and superior wool and mohair products manufactured in the most modern and efficient manner. Such new products will provide greater resistance to wrinkling, soiling, yellowing, abrasion, pillion, mussing, fraying, mildew and insect attack as well as permanent dimensional stability in use.

Optimum Use of Wool and Mohair with Non-Wool Fibers in Blends. One reason for the rapid expansion of markets for synthetic fibers has been the judicious use of fibers with special characteristics in blends to make fabrics with desired performance characteristics, especially durable press fabrics. The possibility should be investigated that chemically modified wools and mohair could be substituted for the high percentage of synthetic fibers now used in wool-synthetic blends or be used with other fibers to make superior fabrics.

Wool and Mohair Modification. Research should take advantage of the wide opportunities now open for advantageously modifying wool and mohair through application of high-energy electromagnetic as well as radio frequency plasmas and corona fields. Such fields can promote chemical reactions in wool which otherwise occur with difficulty or else not at all.

Hides, Skins, and Leather Utilization:

The growing volume of substitute materials for shoe uppers is encroaching seriously into the leather markets for animal hides. In the past year this has caused a 9% drop in the domestic consumption of hides by U. S. tanners and a decrease of some 3 million in the number of hides exported thus greatly

disrupting the balance between the current production of 35 million hides and the accountable consumption. To meet this threat studies should be continued on the chemical modification of hide proteins to develop leathers with additional new and improved properties to meet the demands of the consuming public and to meet the competitive requirements posed by the substitutes. Research effort needs to be strengthened on the physical, chemical, and biological aspects of hides and skins in order to develop information on the properties of collagen and other components to extend their utilization. Emphasis should be continued on investigations of the dispersion and regeneration of collagen that will permit the development of uses other than the traditional leather markets. More specifically, attention should be given to:

Study of Physical Properties. Investigations need to be intensified on the physical properties of leather in order to obtain information on the molecular and structural features that contribute to the performance characteristics and serviceability for use in guiding the development of test procedures for evaluating and for predicting utility improvements.

Engineering Studies. Research should be intensified on the engineering aspects of hides processing in order to develop new or improved processes for converting hides to leather as well as for preparing the nonleathermaking portions for edible uses. These studies should include work on curing, pickling, and tanning in order to improve the economics of leather production so as to enhance its competitive position.

Study of Quality Factors. Investigations should be intensified on the characterization and identification of hide defects that affect hide and leather quality with a view to develop programs for their elimination thereby reducing losses to the tanning industry and improving the competitive position of leather.

B. Human Nutrition and Consumer Use Research

Fat and Cholesterol Metabolism. The Committee gives highest priority to research on how diet regulates fat and cholesterol metabolism. Fat and cholesterol metabolism are implicated in both heart disease and stroke, major causes of disability and early deaths in the U. S. Research to determine the dietary adjustment needed to delay physiological changes associated with aging such as heart disease is of utmost importance. The Committee commends the Department nutritionists for their progress in clarifying the interrelationships among food components in supporting health and well-being throughout life and in succeeding generations. This research should be accelerated and should include study of differences among individuals in synthesizing, storing, and mobilizing fat and cholesterol. The effect of consuming foods of animal origin upon fat metabolism is not clearly understood. Data on the role of eggs in the diet are inadequate. Research also is needed on the forms of fat, minerals, and other nutrients in eggs, meat, and dairy products so that their nutritive contribution to the diet and in relation to other foods may be better understood.

Relationship between Marbling and Cholesterol. According to taste panel studies, well-marbled pork chops and beef steaks are more tender, juicy, and flavorful. Animal fats are being avoided, however, by people concerned about cholesterol. An Iowa study suggests that marbling does not affect cholesterol levels in beef cuts -- that the marbling fat is low in cholesterol. These results should be checked and the investigation extended to pork.

Metabolism of Minerals and their Availability in Foods. The 1965 nationwide survey of food consumption in households indicated that almost 30% of the diets provided less than recommended allowances of calcium and 10% of the diets were low in iron. Nutritional-based anemia has a higher incidence of occurrence than would be expected from this finding. A probable explanation is that part of the iron in food is in a form that the body cannot use. Availability and use of minerals may be affected by the kind and content of other nutrients in the diet. Certain fat carbohydrate combinations in the diet may affect mineral retention. Increased use of commercially prepared and partially prepared foods containing chemical additives such as phosphates has created a need to know their effect on mineral absorption and retention. Research is needed on the nutritional availability of minerals as they occur in foods and upon the effect of nonmineral dietary components on their absorption, excretion, and retention. Information is particularly needed on calcium, magnesium, phosphorus, and iron.

Safe Food Handling Practices for the Consumer. The Committee again directs attention to the need for improved procedures for safeguarding the wholesomeness of raw and cooked foods after they reach the consumer. Research is needed on the problems encountered in homes, institutions, and vending machines, in preventing contamination maintaining the microbial safety and eating quality of foods where it is not practical to provide specialized storage for individual food items. Great care is taken to minimize or completely prevent contamination of food during processing and marketing and still the number of illnesses due to food poisoning remains at a high level. In almost all cases, the cause can be traced to improper handling by the consumer. Research should be undertaken at once to obtain data directly applicable to the problems met by consumers. (See also general recommendation on the need for consumer awareness on food safety.)

Tables of Food Composition. Reliable data on the content of nutrients in foods are becoming increasingly important. The data are essential for evaluating diets and food supplies, for developing sound nutritional guidance materials, and for planning food programs. The effort necessary to update the information on the nutritive value of foods as provided in Agriculture Handbook No. 8 should be increased to include data for important food items and nutrients for which present information is inadequate. The Committee recognizes that progress is being made toward improving the presently available data for certain dairy and poultry products and urges the initiation of studies to provide reliable data on the nutritive values for other important animal products that were omitted or inadequately treated in the Handbook for lack of suitable data.

The Committee urges that the necessary steps be taken for increasing the scope of the Handbook to include data for tocopherols and additional B-vitamins and much more complete data on the content of fatty acids and magnesium in foods than could be provided in the 1963 edition.

Food Consumption Survey. The Committee commends the Department on the extent and kind of information made available in Report No. 1 from the 1965-66 nationwide food consumption survey and in the preliminary report on dietary levels of households. The data on quantities and money value of different kinds of foods consumed in households of different income levels and in different areas are of major significance to the food industries, to agricultural planning, and to food programs. The Committee urges that careful study be made of the decline in quality of diets revealed by this survey and that attention be given immediately to correcting deficiencies of calcium and vitamin A value through increased use of dairy products. Data on the consumption of food by individual members within the family are of special significance in developing action programs to improve the quality of diets. The Committee urges the release of the data collected on food consumption practices of individuals at the earliest possible date.

Improving Children's Food Habits. The Committee recommends that a study of food practices of children be made as a basis for developing food programs and food guidance materials aimed at improving diets of the preadolescent. A pilot study needs to be made to investigate food habits and to identify the most effective procedures for bringing about improvement. Results of this study should be useful in directing future research on dairy, meat, and poultry products.

VII. MARKETING AND ECONOMICS

A. Market Quality

Dairy Products:

Market Quality of Fluid Milk. Recent developments in the handling, transportation, and processing of fluid milk have caused many changes in the merchandising of this product. Research should be initiated to determine the effect of these new practices on the keeping quality of fluid milk. Information is needed on (1) the effect of the ultrahigh temperature extremely short-time pasteurization procedures on flavor and other quality attributes of milk during the time it is in storage and channels of distribution, and (2) on the numbers and kinds of micro-organisms in milk marketed under these newly created conditions.

Milk is in danger of losing more of its market to competitive synthetic substitutes. Research is needed to experiment with new flavors for milk such as blueberry milk, orange milk, grape milk, and other popular flavors. Also, there is need to study additives to determine possibilities of lengthening the shelf life of milk drinks.

Heat Stability of Bacteria and Salmonella. Preliminary work has shown that bacteria and salmonella apparently "killed" by heat may recover their ability to grow normally after a period of time. The extent of heat damage and recovery depends on the heating medium and the recovery medium. Little is known of the mechanism of heat damage to bacteria and salmonella. This work is of fundamental importance to those concerned with the reduction of bacteria and salmonella in foods by heat processing. Research should be expanded to obtain more information about the nature of thermal injury and recovery of bacteria and salmonellae.

Poultry and Eggs:

Salmonella in Eggs, Poultry, and Poultry Products. The highest and most urgent priority should be given to reducing the incidence of salmonella in eggs and poultry. Investigations are needed to determine under what conditions salmonella proliferate in poultry, eggs, and in egg and poultry products during processing, handling, storage, and distribution. For this purpose and for use in poultry inspection, simple, rapid, and economical methods are needed for detection of salmonella to assist in its eradication.

Insure Food Products Free from Toxic Residues. Research should be accelerated to determine rates of accumulation and depletion of pesticides in poultry and eggs and methods for quick detection developed in order to cope with problems posed by regulation. Continued and increased attention is being given by various governmental regulatory agencies to pesticide residues in human food. Some work is already underway toward intelligent control of pesticide residues in poultry and eggs. In this connection, studies are needed to ascertain reasonable and acceptable tolerances of pesticide residues in human food.

Quality Maintenance of Eviscerated Poultry. Research should be continued to determine the effects of various existing methods (as well as new or improved methods) of slaughtering, scalding, defeathering, eviscerating, chilling, packaging, transporting, and holding on the quality of eviscerated chickens and turkeys. Factors such as color, shelf life, flavor, tenderness, and wholesomeness as affected by various processing techniques should be studied. Basic research to elucidate the physiological, chemical, and physical processes involved in the maintenance of poultry meat quality should be an integral part of this study. Particular emphasis should be placed on a method for relaxing birds before killing to learn whether bleeding is enhanced and whether any change occurs in meat quality.

Livestock, Meat, and Wool:

Measurement of Market Quality. Research is needed to provide improved methods of quantitative and qualitative evaluation of both live animals and dressed meat. There is need to develop accurate methods of measuring the ratio of lean muscle mass to fat tissue. Also, such studies should include methods of measuring tastiness and tenderness of meats.

Shelf Life of Fresh Meat and Poultry. Additional research is needed to increase the shelf life of fresh meats in retail markets in addition to the research already conducted on refrigeration, sanitation, and lighting with particular attention toward minimizing bacteria and possible salmonella contamination. The high quality of meat and poultry products available to consumers came about as the result of modern production practices, transportation systems, and engineering related to traditional preservation methods. Maintaining quality of the products against micro-organisms, insects, moisture, chemical changes, and physical factors such as light and temperature, continues to be a serious problem in marketing. This deterioration in quality causes reduced consumer satisfaction and demand for the product, contributes to lower prices to producers, and to reduced margins for processors and distributors.

Standards for Meat Grades. Present standards provide for grading beef from steers, heifers, and cows without sex identification. Beef from bulls and stags is graded as bull beef and stag beef, respectively, and identified for class as "bull beef" or "stag beef." At present, the quality in a designated grade of bull beef (and stag beef) is not comparable with a similarly designated grade of beef from steer (heifer and cow). It is recommended that this problem be brought to the attention of the Grading Service of the Livestock Division, C&MS, for early consideration and inclusion in grade standards and specifications.

Objective Measurement of Wool Quality. Improvement of present methods for measuring quality factors of the wool fiber would contribute to the development of better grading procedures that would be more closely related to processing performance and product quality. The study at the University of Wyoming should be continued.

Standards for Mohair Classification. Mohair standards are needed. A set of standards for mohair classification should be established including measurement of fiber length, density, fineness, and character.

Stored-Products Insects. There is need for a current determination of the kinds of insects and mites that are of importance where dairy products are manufactured, shipped, and stored. The research should also produce information on the distribution, abundance, and relative importance of the various species as a guide for control recommendations and the nature of the research program directed to developing improved control measures.

The insects that attack woolens in the home are a major cause of losses by stored-product insects. They are abundant and occur throughout the entire country. The individual items they damage or ruin are often expensive. A report from State Extension workers shows that the number of requests for information on fabric-insect control leads all other insect inquiries in most States. Research should be expanded to develop safer, more effective moth-proofing treatments that can be applied in the home and during the manufacture of woolens.

Increased research is urgently needed to determine as soon as possible the role of insects in the transmission of salmonella to food and feed. Where direct relationships are found there must be a prompt, intensive effort directed toward finding ways to break the links in the chain of transmission.

B. Transportation, Equipment, and Facilities

We wish to recommend the continuation of work on the following studies in process from our 1967 recommendations so that they may be brought to conclusion: (1) research on egg handling methods and packing plant procedures, (2) handling and bruising of live poultry, (3) turkey eviscerating equipment and crew balance, (4) water conservation in poultry processing plants, (5) handling and processing "hot" pork products, (6) layouts and operating criteria for livestock auction markets, (7) operating veal boning lines, (8) overseas transport of poultry products, (9) polystyrene foam containers and CO₂ in-package refrigerant, and (10) multipurpose transport vehicles.

The following new or modified studies are recommended:

Retrieving Edible Meat Now Lost in Boning Operation. Nondestructive means need to be developed for retrieving meat for human consumption that is now being processed, along with the bones, through rendering plants because it cannot be removed economically by conventional boning methods.

Rendering Plant Design. With the present concern about air pollution, it would be desirable to have a rendering plant that would not give off offensive gasses. There is need to design a building that would provide a more sanitary condition to prevent contamination of its rendered products and eliminate offensive odors.

Milk Processing Techniques and Equipment. With the rapid growth of finished manufactured food products, there is an everincreasing need for new processes and new equipment. The role of USDA should be to conduct research that would provide information on processing and equipment that would be useful to the manufacturers of dairy products as well as suppliers of equipment in the improvement of equipment and its use.

Contamination of Poultry and Poultry Products during Processing. Facilities, equipment, and methods for handling powdered egg and other poultry products need to be developed that will eliminate contamination hazards in handling and packaging finished products. This need is of a high priority because of the danger and unknown aspects of spreading salmonella at processing and packaging levels.

Handling and Transporting Livestock. Shrinkage, stress, bruising, and death cause heavy losses in the livestock industry. Research should be continued to eliminate losses due to handling of livestock at markets and in transit. Feeder cattle and calves suffer from fatigue and exposure on long hauls and often arrive in a weakened condition susceptible to disease and, at best, set back in their growth. The feasibility of transporting feeder cattle, lambs, calves, and fresh meat by air needs to be investigated.

Transportation and Services. Recent developments in transporting and handling of overseas products, such as containerization, afford an opportunity to get U.S. agricultural products to overseas markets in better condition and at lower cost than with present transport equipment and techniques. Research is needed to determine how and under what conditions these new techniques can be used for shipping and handling specific commodities to overseas markets to reap the most benefits from improvements. Work on developing improved transport equipment, techniques, packages, and shipping containers for overseas shipments of U.S. agricultural products should be expanded. Costs and efficiency in marketing agricultural and food products depend to a large extent upon how effectively the transport requirements of the physical distribution system are met. Research should be undertaken to find ways to improve coordination of transport services for agricultural products and farm supplies.

C. Economics of Marketing

We are repeating a recommendation first made in 1965 for an overall study of livestock marketing which was greatly needed then. With each passing year, the problem has intensified. We are disappointed that the USDA has not been able to provide the necessary leadership to conduct such a study. We urge that an all-out effort be made by USDA to organize such a study in cooperation with the State Experiment Stations. If this is not possible, we then recommend that the Cooperative State Research Service arrange for conducting the study through regional research groups or any other feasible approach. The original recommendation, with some updating, is as follows:

Overall Study of Livestock Marketing. The economic structure of the nation's livestock and meat production-marketing complex is in the midst of great change. Livestock marketing and processing facilities are becoming more decentralized during a period when most marketing and processing operations for other agricultural products are becoming more centralized. Large multispecie packing plants, located in major industrial centers, are being replaced by efficient specialized plants located in livestock production areas.

Very large sums of money are now invested in the present structure of livestock marketing and processing which handles a portion of our food supply equivalent to about half the value of consumer expenditures for

food. There has been a great proliferation of packer and processor buying operations, markets, market agencies, and dealers in the assembly of livestock. The great numbers of these, many not providing either adequate or economical service, represent inefficiencies and high cost that the livestock industry cannot afford to support now or in the future. Because of the changes occurring in this very important segment of the U.S. economy, all those concerned with it from producer to consumer need information so that livestock producers, especially, will be aware of the costs of the marketing machinery they are supporting and to provide such other information as will guide them in making future decisions.

A benchmark study is needed that would encompass historical, geographical, technological, and economic developments of the livestock and meat production-marketing complex. This study could provide information on costs and services rendered by the various components of the marketing system which would help explain the influence of various factors that have contributed to the changes. It should be conducted simultaneously throughout the country within the period of a single year and encompass all the marketing activities from producer to consumer.

The following studies are very important and may constitute a part of the overall study of livestock marketing referred to above:

Price Communication and Pricing Procedures. The decentralization of livestock marketing has made it more difficult to determine the supply and demand of livestock on any given day. Ways must be found to either make competitive pricing continue to function effectively or else find some workable alternative. As marketing continues to decentralize, the effectiveness of price formation, price communication, and resource allocation are expected to decrease unless new procedures are adopted. Problems associated with the use of the "yellow sheet" and USDA quotations will intensify with increased use of "advance contracting" and "open pricing." The number of transactions that cannot be used as a sound basis for quoting prices by reporting services will increase.

Price Effects of Packer Feeding and Packer Contracting. Packer feeding and advance contracting are increasing. The Packers and Stockyards Administration has presented data indicating packer feeding of cattle has an effect on prices at given markets. We recommend studies of other markets, interregional effects on price, expansion of the studies to sheep and hogs, and suggest that the Economic Research Service assist the Packers and Stockyards Administration to expedite these studies for early evaluation.

Wholesale Meat Price Quotations. Much controversy surrounds the accuracy and relevance of prices quoted on red meats in the "yellow sheet" and their effect on day-to-day wholesale meat transactions and, in turn, on prices to livestock producers. A study of this price source is recommended to determine its effect on pricing of meat and livestock. The

importance of this recommendation is recognition of the fact the formula-pricing appears to be on the increase both in meats and livestock, using the price source as a base.

Grade-Composition of Commercial Beef Carcasses. We are in the beginning stages of a large increase in the meatiness of beef animals. To provide a benchmark from which future progress can be measured, a study is needed of the present yield grade composition of the national supply of commercial beef carcasses, particularly good and above grade carcasses. A sample of beef slaughter plants should be taken to document this total composition of the supply. Such a study was made of the composition of barrows and gilts slaughtered in the U. S. from September 1960 to August 1961. The purpose of that study was to provide a benchmark for measuring future changes in the makeup of the national slaughter supply. It is often referred to as a yield grade consist, using the term "consist" as a noun.

Distribution of Lamb and Mutton. The Committee was sorry to learn that a study recommended previously pertaining to lamb and mutton had not been undertaken because of lack of support by the meatpacking industry. We are repeating the recommendation and request that cooperation be sought through the American Meat Institute:

"The sheep industry has relied heavily on a study of distribution of lamb and mutton in the United States as it occurred in 1954. Due to the high level of mobility of the population and its expansion, it is reasonable to assume that consumption patterns for lamb and mutton have changed since the 1954 study. It is recommended that research be conducted to bring the above study up-to-date."

Rabbit Meat. Market research is needed to determine a logical direction for increased promotion and increased consumer acceptance of rabbit meat. Rabbit production is increasingly a source of income for retired people and small holders. It is one of the few remaining practical vocations available for people with little capital and without special technical training. The small scale of most rabbit producer's operation precludes their doing this sort of research for themselves.

Pricing Plans for Milk. In view of changing market conditions in the current dairy situation, the Committee recommends a study of alternative methods of paying for milk. Such a study should include price relationships among the fat, solids-not-fat, and protein components of milk and their effect on the pricing structure of the major dairy products.

Milk Regulations. Changes are occurring in the marketing and production of milk, including the interstate movement of milk. Producers and others in the industry are demanding government participation in the pricing of this milk. States are entering the area of trade practice

regulation more and more. A comprehensive evaluation of these institutional conditions in the fluid milk industry is needed periodically. This was last done in 1965.

The Committee was pleased to learn that the following studies recommended last year have or soon will be activated:

Trade Barriers in the Dairy Industry. The National Commission of Food Marketing and others have recommended a study of the costs of overlapping health jurisdictions and impediments to the movement of milk both in bulk and packaged form. This study should determine the extent and cost of such duplicate inspections and other regulations.

Market Potential for Dry Whole Milk. Because of recent technical improvements in drying whole milk, a marketing assessment of the potential for instant beverage quality dry whole milk is needed.

D. Cooperative Marketing

Potentials of Integration. Information should be developed as an assist to farmers in appraising and developing feasible programs that will enable them through their own cooperatives to maintain control of their products at additional decision-making levels in production, slaughter, processing, distribution, and marketing. These studies should determine costs and benefits in relation to changes in marketing structure.

Combinations of Cooperative Service. Research is needed to determine the most efficient combinations of cooperative marketing services and products for livestock and poultry producers based on market requirements. This research could help farm families and cooperatives schedule farm production, farm resources, and credit through cooperative management centers more effectively.

Cooperative Structures and Organization. There is need for cooperative organization structures and operating methods able to serve large areas. Large-scale cooperatives can achieve operating efficiencies, provide improved bargaining power to farmers, and help to balance surplus and short supplies to meet interregional market needs. Research is needed to develop necessary guidelines for these purposes.

Coordinated Marketing. Research is needed to determine geographic areas that offer greatest potential economic gain from coordinated marketing of related cooperatives. Research would then be needed to evaluate potential growth effectiveness and methods of coordinated marketing programs in selected areas.

Pooling. Increased research is needed to assist cooperatives formulate a pooling system, or systems, designed to equitably distribute proceeds from sale of their product in multistate areas back to producers also widely

located over large areas. Such research would assist cooperatives, particularly dairy cooperatives, in their current efforts to federate into large bargaining units.

Service and Assistance Studies. Consistent with the increasing interest in increasing producers ability to bargain and thus the interest in maintaining strong cooperative bargaining and marketing associations, this Committee encourages and endorses the availability of Farmer Cooperative Service personnel to make short-term service and assistance studies for existing cooperatives to insure their strength and vigor through efficient study and operations.

E. Supply-Demand Research, Situation, Outlook, and Projections

In recognition of the increasing importance of the work in these areas, the Committee would like to suggest consideration of the Department in increasing manpower in these two research areas to give greater assurance of up-to-date and accurate projections, situation and outlook reports so dependent on updated supply-demand data and relationships.

As to specific studies needed, we would like to recommend the following:

Changing Patterns in Demand for Meat, Poultry, Eggs, and Turkeys.

Important shifts have been occurring in the demand for meat and poultry products in the past decade. The shifts that have been taking place for the individual meats are related and a thorough analysis is needed to determine the extent to which these shifts have added to the total demand for meat. A comprehensive analysis is needed which will combine analyses using data from the 1965/66 Household Food Consumption Survey with analyses using historical data to trace out changing demand patterns and to forecast probable future changes.

Factors Affecting the Demand for Milk and Dairy Products. Domestic consumption patterns of milk and many dairy products have undergone substantial changes since the last comprehensive study of demand for dairy products was made in the mid-1950s. This is exemplified by the down-trend in milk consumption and declines in commercial sales of milk and many dairy products despite rising consumer incomes. The development of more substitute nondairy products and filled milk products and competition from other foods suggest that consumption of dairy items may have become more sensitive to price and other factors than formerly.

Supply-Demand Relationships for Poultry. The changes which have occurred in technology, organization, structure, and practices in poultry and egg industry have altered the relationship of the industry to food retailers. These changes have progressed to such an extent that establishing live prices for broilers and to some extent turkeys is becoming increasingly difficult. New analyses are needed of the factors

affecting supply and demand based on wholesale and retail prices for ready-to-cook broilers to replace older studies using farm prices for live broilers. Similar analyses are needed for turkey using wholesale ready-to-cook prices instead of farm prices for turkeys.

Study of Program Outlets for Dairy Products. CCC purchased and accumulated substantial quantities of butter in 1967 and is expected to continue substantial purchasing in 1968. Quantities of butter and nonfat dry milk in CCC hands are more than are needed for domestic programs. However, problems exist in expanding foreign program outlets for U.S. dairy products. Foreign supplies of butter are above normal; vegetable oils are being used in donation programs which formerly utilized butter and butteroil and CSM - a corn, soybean, milk blend - has been developed as a high-protein food for foreign programs. Therefore, less nonfat dry milk is needed for foreign feeding programs than formerly. Since, under current world conditions the U. S. can expect very limited commercial dairy exports, analysis of alternative program opportunities for dairy exports would be particularly timely.

Forecasting Models for Livestock and Meat and Wool. There is need to continue to study and update the models used in searching for alternative methods of estimating annual and quarterly cattle, hog, and lamb slaughter and beef, pork, and lamb production, forecasting livestock slaughter, and prices, seasonal adjustment factors for meats; also including applicable models for wool consumption, and an appraisal of wool's share of total fiber use.

Dairy Outlook and Milk Statistics. There is increasing specialization and a large investment in specialized dairy equipment indicating a greater emphasis is needed on the outlook for intermediate and long-term periods. Improved estimates are needed indicating the resources required for various levels of milk production based on estimated domestic consumption levels and possible levels of food assistance programs. Projections for milk production and utilization as have been started on a preliminary basis should be continued.

Supply and Price Study for Chickens, Eggs, and Turkeys. Often price patterns change for chickens, eggs, and turkeys. There is need for clarification of the reasons whether caused by localized market concentration or wholesale and retail unseen practices that keep perpetuating these situations.

Economic Factors Affecting the Feed-Livestock Economy. There is need to continue to study and update the relationship between animal numbers in terms of grain consuming, total livestock products produced, and the total tonnage of feed grains and other concentrates fed to animals. This information should improve the estimates of feed consumption during the year.

F. Consumer Attitudes and Preferences

This area of work is becoming of increasing importance as we experience both the need for and actual development of new products, the sampling of attitudes, and appraisal of existing products. We recommend that consideration be given to increasing the manpower levels in areas of consumer attitudes research pertaining to animals and animal products -- specifically the following:

New Food Processes. Additional research is needed on homemakers' reactions to the idea of relatively new methods currently being employed or considered in the processing of foods such as irradiation, freeze-drying and other methods of food preservation including all frozen meats and poultry.

Consumer Preference for Cotton and Wool Products. Manmade fibers and blends have moved aggressively into the textile market and provided sharp competition for the natural fibers making the need for sound information on consumer reactions on a nationwide basis even more urgent. Consumer preference research on cotton, wool, and competing materials should be expanded to provide this information. Studies which should be given high priority include consumers' opinions of and preferences for cotton, wool, and blends of wool-cotton, wool-manmade fiber, and cotton-manmade fiber, and competing materials in men's wear, women's wear, children's wear, and household products.

Consumer Reactions to Test Products used in the Homes. To assist in the initial efforts to market new and improved food products of agricultural origin most effectively, industry needs to know homemakers' reactions to such innovations. Research should be expanded on the opinions and preferences of consumers concerning new products through the placement in households, for use under more natural conditions than a laboratory provides, of various items such as fruit juices and other food products as they approach commercial introduction. In addition to providing industry and the laboratories with information about any previously unknown or suspected shortcomings of new products (such as difficulty in reconstitution or in following reconstitution instructions), household placement tests which indicate better-than-average acceptance of a given product provide added inducement to a potential processor and others in the marketing channels to introduce the line.

Attitudes toward Fluid Milk. A consumer survey of attitudes and opinions concerning fluid milk as to reason for consumption and/or decreasing use and who uses it or declines to use it, in order to more positively promote consumption of fluid milk. At the same time, to relate the attitudes and opinions to those associated with the newer imitation and filled milk products and to provide a base for comparison of data.